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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION

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NOTES AND COMMENTS.

Body.

Closely allied to the question of inherent properties in pig-iron is the one of "body" in crucible steel. Walloon bar has always been much dearer than Swedish-Lancashire bar iron, though of similar composition, the difference being ascribed to "body." When electric furnaces were first introduced to Sheffield, the general consensus of opinion was that its product lacked this indefinable virtue of "body." With the introduction of new steel-making alloys came, explanations based on the inadequate knowledge of the influence of the rarer metals on steel. The presence of vanadium was constantly referred to as being a likely element to account for the superior properties bestowed by any brand of Swedish bar iron. By perseverance, the electric steel makers proved that the furnace was quite capable of manufacturing many types of steel quite successfully, and with its development, efforts were made to speed up the process by the installation of more powerful transformers for any given furnace capacity. This permitted of the use of a much higher voltage for melting, whilst maintaining the same amperage. With the higher voltage is associated a longer arc. However, the product from the highly-powered furnace was thought to suffer, and once again the question of "body" was being put forward, this time that the higher temperature destroyed the "body." A committee was formed in the United States to study this and other electric furnace problems, and Mr. E. T. Moore, who reported to the Association of Iron and Steel Electrical Engineers at their Chicago Conference, put forward a reasonable explanation. He assumed that nitrogen was injurious to steel, and as the fixation of nitrogen increases with the length of the arc, ideal conditions are brought about for the thorough incorporation of this element with the highly liquid steel. A great amount of subsequent short-arc-refining is required to remove this.

Here is offered one reasonable explanation of a phenomenon which might in the past have been ascribed to "body," and as the influence of gases becomes better understood, so will reasonable explanations be forthcoming for many obscure phenomena.

Information is not available as to the voltage (or arc-length) used for the refining of cast-iron, but our experience has shown that a low voltage is preferable, but in the States high voltages are more frequently encountered than here, and it may be that long arcs are used. Should this bring about a contamination with iron nitride, with its typical interlacing needle structure, the question naturally arises whether such a structure in combination with a finer graphite plate structure than normal would be injurious or beneficial for cast-iron. Such a question we would leave to the theoretical metallurgist. In considering the general question of "body," we would remind the theorists that, generally speaking, the following data are substantially correct and should be borne in mind:—(*a*) Smaller units produce a superior material to the larger units. (*b*) The more mechanical contrivances introduced for the operation of any furnace, the less likely the production of the very highest grade of material. The reason for this is that the operator is further removed for his process by each work-saving device. Theoretically, it should leave him more time to study the intricacies of the process, but in reality it acts in the reverse direction. Whilst this may, on the surface, appear to be a reason for the non-adoption of modern plant, a deeper investigation shows that once these questions of "body" have been solved, the high grade material will be capable of being reproduced by modern plant, the only difference being that it will be the metallurgist, and not the furnaceman, who will be responsible for its reproduction.

Mr. McLain's Visit.

We understand that Mr. David McLain, the originator of "McLain's System of Semi-Steel" will arrive in this country on October 22. He has already received invitations to address some representative bodies of foundrymen, and much of interest should be disclosed. Mr. McLain has done much to improve foundry conditions in the United States and Canada, and we feel sure that he will be well received by foundrymen of this country.

The Liege Foundry Exhibition.

The Liège Exhibition which has just closed was made up of some eighty stands, which showed both the material for and the product of the foundry. Additionally several stands were devoted to the apprenticeship question.

Amongst the exhibits of interest to the British foundrymen were:—

Etablissements Alfred Baré et Cie., 12 to 14, rue des Maraichers, Liège. This firm were showing a selection of chemical products and machines for the preparation of foundry blackings.

Anciennes Sablonnières Joly, 128, rue des Quatorze-Verges, Ans.—Various types of sands.

Soc. An. des Etablissements Ph. Bonvillain et E. Ronceray.—This firm showed a selection of moulding machines in operation, and many of their well-known foundry specialities.

British and Continental Traders, Ltd., Brownlow House, 50, High Holborn, London, W.C.1.—Special pig-irons. As this was the only British House exhibiting, an illustration is given of their stall. It will be noticed that they represent the well-known houses of Messrs. G. & R. Thomas and the North Lonsdale Iron & Steel Company.

The Exhibition of Messrs. British and Continental Traders, Limited.

Etablissements Métallurgiques N. Detiffe, 85, Boulevard Clovis, Brussels.—Waterhouse plumbago, crucibles, phosphor copper and phosphor bronze.

Gustave Dister, Place de la République Française, Liège.—Amongst other materials this firm was showing Luxemburg and Lorraine foundry pig-iron, ferro-alloys, sand mills, special core sand and a patented system of foundry ladles.

Julien Dubois, 34 rue de Ponçay, Bressoux.—Moulding sands.

Soc. An. Electricité et Electro Mécanique, 19, rue Lambert Crickx, Bruxelles-Midi.—This large exhibit included high-pressure blowers for mould-drying stoves; hoisting apparatus, such as winches and cupola hoists.

Soc. An. Fabrique Belge d'Emaux, Trooz.—Special enamels for cast iron and sheets.

Fenwick Frères, 10, Boulevard Baudouin, Bruxelles.—Tabor pneumatic moulding machines and general foundry supplies.

Paul L. Francken, 29, Avenue Louis Lepoutre, Brussels.—This firm are agents for the French Comptoirs for ferro-chrome and ferro-silicon, for Keller et Leleux, Levet (synthetic pig-iron), the Hilex Iron Company of Hull, and the Wellman, Smith, Owen Engineering Corporation of London, and showed the products of these firms.

Soc. An. Etablissements François, Schlessin.—This company had an interesting exhibit and showed machines illustrating the use of compressed air in the foundry, including its application to compressors, hammers, riddles, sand-blasting machines and hoists.

La Soc. An. Integra, 20, rue de la Vieille Montagne, Liège.—Measuring instruments for gauging cupola pressures.

Isbecque, Todd et Cie., 36, rue Ottlet, Brussels.—"Osborn" jar ramming machines, pneumatic tools, etc.

Joachim Raven, 31, rue de Frugnée, Liège.—This firm showed a selection of their fettling machines, such as sand-blast apparatus, together with its dust-removing attachments and air compressors.

T. Ketin et F. Thiriart, Schlessin-lez-Liège.—The exhibit of this firm included a large range of foundry supplies, including cupolas, ladles, blowers, converters, hoists, automatic chargers; sand-preparing machinery, such as mills, riddles, mixers, moulding machines, magnetting machines; portable core stoves, coke dust stoves; core-making machinery. Their outstanding speciality was a patented system of mould-drying furnace.

Ateliers Ivan Lamoureux, 49, rue du Val-Benoit, Liège.—This firm, who undertake the complete erection and installation of foundries, from the sand-mixing plant to the machinery for fettling the castings, showed amongst other things Morat's patented jar ramming moulding machine, the British product Cupoline, which is used for lining cupolas and convertors, and "Belgica," a non-contracting white metal for pattern plates.

Morgan et Cie., 28, rue du Pont Neuf, Brussels.—The Belgian house of Messrs. Morgan & Co. of Battersea had a range of the well-known "Battersea" products.

Compagnie des Produits Industriels Oxi, Haren, showed some foundry specialities, including pattern varnish, cement for repairing cast-iron castings, various enamels, and anti-corrosive paints.

Pirlet-Brassine Joseph, 68, rue Philippe-de-Marnix, Seraing, exhibited their sand preparation plant—mills, mixers and aerators.

Soc. An. des Fours Rousseau, Argenteuil France, exhibited furnaces for metal melting, and plumbago crucibles for copper, aluminium and malleable iron foundries.

Soc. An. M. A. Scholten's Chemische Fabriken, Groningen (Holland), showed samples of "Quella," a core-gum powder form.

Correspondence.

[We accept no responsibility for the statements made, or opinions expressed, by our correspondents.]

Electrically Melted Cast-Iron.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—We have read with interest reports in the FOUNDRY TRADE JOURNAL of the Blackpool Conference. From what we can gather, it would appear that many of the founders in this country are very sceptical of the results obtained by treating cast iron in the electric furnace in any manner whatsoever. The process under discussion seems to be that of melting cast iron in the cupola and then transferring it to an electric furnace for refining; and there is no doubt whatever that a very much improved cast iron can be obtained in this way. We have been making a study of the treatment of cast iron in the electric furnace now for some years, but we have gone on rather different lines from those discussed in the journal.

We are not only iron founders, but have for many years run a successful steel foundry, and from research work which we have carried out here, we have come to the conclusion that, if cast iron were studied in the same way as it is imperative that steel be studied in order to produce satisfactory castings, an improved product could be found. After preliminary investigations, we came to the conclusion that, if the grain of cast iron could be reduced and the sulphides and phosphides eliminated, the results must be increased strength. On examining ordinary high-grade cylinder iron under the microscope, we saw that, in the very best of iron, there were patches of sulphide and phosphide and the carbon stood out in lumps. The grains themselves seemed to be held together in a very loose manner, and these observations confirmed our previous decision. On examining under the microscope the product which we have now produced, we find that sulphides and phosphides have been practically eliminated and that the grains of the metal are separated only by hair-lines of graphite. The general aspect of the mixture gives the idea of strength. After a very long series of experiments we have arrived at a composition which not only gives fine grain and high tensile strength, but is comparatively soft, the increase in hardness over ordinary cylinder iron being only about 11 per cent. During independent tests taken at the Shipbuilding and Engineering Exhibition on a neighbouring machine some of our tensile test pieces broke at 21.2 tons per square inch, and a delegation of the London Branch of the Institution of British Foundrymen was present when some were broken in the region of 20 tons per sq. in. Transverse bars, 2 in. by 1 in. by 3 ft. broke at 39 to 40 cwt., with 7-16 in. deflection. As regards hardness, the Scleroscope number is 53 and the Brinnel 256.

Our method of manufacture really consists of forming white cast iron in the electric furnace and then forming grey iron by the precipitation of carbon by means of ferro-silicon. We also add ferro-manganese according to the original analysis of the metal in the furnace. A typical analysis is T.C., 1.75 to 2.25: Si, 2.5 to 3.0: Mn, 0.7 to 0.9; S, 0.03 to 0.06; P., 0.03 to 0.07. In arguing our case we lay stress on the fact that our method of manufacture produces nascent cast-iron. By this we mean that the grey iron produced is grey iron for the first time. If our "Granfin" iron were melted and remelted by passing it through the cupola, its grain will become coarser and its strength decrease. Although the phosphorus is exceedingly low in "Granfin" iron, its fluidity is as near perfect as possible. This is probably due to the high temperature at which it is poured. We quite agree with remarks that have been made in your journal on the pouring temperature of cast iron, and it is essential that "Granfin" iron should be poured at its own peculiar temperature in order to obtain the highest results.

From criticisms we have received from various quarters during the Exhibition in London, we are confident that it is only metallurgists who can see the reasons why cast iron can be improved by treatment in the electric furnace.

From our experience of steel founding and from information we have gathered from a long series of experiments with "Granfin" iron, we have come to the conclusion that, unless cast iron is handled very scientifically and with the same care as steel in the electric furnace, disastrous, rather than good, results will be obtained.

If there is any further information we can give to your readers as regards our "Granfin" iron, we shall be only too pleased to do so.—Yours, etc.,

C. R. MATTHEWS, General Manager.
THOMAS SUMMERSON & SONS, LIMITED.

Darlington,
October 6.

The Testing of Cast Iron.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The two papers read at the recent conference of foundrymen are, as you remarked editorially in your issue of the 22nd ult., so intimately associated that the discussion on the one may be immediately applied to the other. With your permission I should like to draw attention to one or two points which were apparently not mentioned in the discussion.

Mr. G. K. Elliott, in his paper, stated that the cast iron produced by both the cold charging and the duplexing processes was employed for making valves to handle power steam of great pressure and high temperature, and that castings so produced were of a better quality than any that had previously been commercially attainable. The results given in the table are, however, disappointing, and do not indicate iron of a greater strength than we can obtain regularly from an ordinary cupola. The analyses do not help much, for if they are judged at their face value in the ordinary way Heat No. 1191 should be stronger than Heat No. 6271, yet such is not the case. The figures are compared below in order to show up this point more clearly:—

Heat	Process.	T.C.	Si.	Mn.	P.	S.	Transverse test arbitration bar.	Calculated transverse test on 12×1×1
6271	Dup.ex	2.16	1.77	0.73	0.58	0.018	45.5	33.7
1191	E.F. only	2.94	1.52	0.62	0.27	0.009	37.0	27.4

This comparison shows the iron of purest composition and lowest total carbon content to have the lower physical strength. As this low-strength iron was melted solely in the electric furnace, the claims made for this type of furnace can hardly be considered as substantiated by the figures given. If the iron produced in the electric furnace has advantages—which seems quite likely—then it is plain that further evidence indicative of these properties is desirable before the claims with regard to improved quality of metal can be accepted. The five points offered for discussion by Mr. J. Shaw were dealt with fairly fully except in the case of No. 4, and here Mr. Shaw thought the real point at issue had been somewhat overlooked. This subject of transverse as against tensile test bars is in its infancy. There is no doubt that tensile tests can be conducted more precisely and with greater accuracy. No difficulty arises regarding the straight pull when using a well-designed testing machine of approved make. During the war the French authorities specified the use of cast iron having a certain tensile test in conjunction with a definite impact test value, and this combination is, in the writer's opinion, ideal, and far preferable to the ordinary transverse test bars. If the latter are used with the idea of measuring deflection, then the longer the bar, within reason, the better. A bar 1 in square on 36-in. centres usually gives from 0.5 in. to 1.0 in. deflection, and these figures lend themselves to accurate reading. The tensile bar is simple to make and could be easily standardised for various classes of work. In the writer's estimation it is the bar of the future, and he anticipates the time when a small percentage of elongation or stretch, say up to 1 or 2 per cent., will be obtainable from iron as cast from the cupola and without the aid of any subsequent heat treatment.—Yours, etc.,

ERNEST WHEELER.

Openshaw,
Manchester.
October 5, 1921.

XUM

Reversible Thermal Expansion of Silica.*

By H. S. Houldsworth and Prof. J. W. Cobb.

The authors had previously described the results of some experiments on the reversible thermal expansion of refractory materials, but most of these referred to fireclays, or bodies with a fireclay basis, and only preliminary experiments on silica refractories were discussed. It was apparent, however, from these earlier experiments that the observed character of the expansion curves would give indications as to the transformations of silica occurring in silica refractories under the various conditions of heating, apart from other useful information. Accordingly the reversible thermal expansion from 15 to 1,000 deg. C. was measured for amorphous precipitated silica prepared from silicate of soda and containing some alkali, purer amorphous silica prepared from silicon fluoride, silica glass, ganister (both with and without a lime bond), quartzite and flint, after preliminary burnings to known temperatures. Generally the test pieces were fired in a works kiln to Cone 06 (980 deg. C.) in forty-eight hours or to Cone 9 (nominally 1,280 deg. C.) in seventy-two hours before examination. Afterwards the specimens fired to the latter temperature were burned for two hours in a laboratory furnace at Cone 14 (1,410 deg. C.) and their expansions again determined. They were then fired at Cone 20 (1,530 deg. C.) for two hours and again examined. In this way the changes in expansion due to changes in structure resulting from these preliminary burnings to known temperatures were observed.

As regards silica glass, ordinary commercial samples of vitreosil were used for these experiments so that they would have been prepared from silica in a pasty condition rather than from completely fused silica. Summarising the results with this material, the authors stated that the experiments showed that little change took place in the vitreosil tubes by repeated heatings to 1,000 deg. or by four hours' burning at 1,150 to 1,170 deg. C. After firing for three hours to Cone 14 some tridymite appeared, while heating for 2½ hours at 1,510 to 1,555 deg. resulted in from 30 to 50 per cent. of the vitreosil being transformed into tridymite according to the indications of refractive index. In all their other experiments cristobalite had been the form of silica produced in quantity at high temperatures, but it must be remembered that it was possible the tridymite obtained in this case was in an unstable form. The vitreosil was not in the form of a powder, and consequently might not be transformed as readily as finely divided substances. Ricke and Endell found that when powdered quartz glass was heated at 1,400 deg. for two hours, 25 per cent. of it was converted into cristobalite, while two hours' burning at 1,500 deg. C. transformed the whole of it into cristobalite.

Meanwood Ganister.

In the case of Meanwood ganister, it was found that burning it without bond to Cone 9 repeatedly or subsequently heating to Cone 14 for two hours caused a small part only of the quartz to be converted into cristobalite, and that tridymite was not produced at all. On firing to Cone 20 for two hours, however, the whole of the quartz was transformed into the lower density modifications of silica, cristobalite being in very large excess of the tridymite produced. The difference between the heating and cooling curves of the ganister bound with plaster and fired to Cone 06 or to Cone 9 was remarkable. In each case the change in dimensions between 500 and 600 deg. C. was greater on cooling than on heating. This did not apply in the case of a test piece cut from a block of ganister burned repeatedly at Cone 9, for here the heating and cooling curves practically coincided. A similar difference between heating and cooling curves was noticed in the case of fireclays containing free quartz. The condition with fireclays was analogous to that of ganister bound with lime, for in both cases fluxes were present with the quartz. The transformations from $\alpha - \beta$ quartz are apparently not strictly reversible changes in mechanical structure. But since very little permanent change was noted in the dimensions of the specimens after heating in the apparatus, the particles presumably regained very nearly their original positions on cooling to air temperature. It was also noticed that the coefficient of expansion of the ganister decreased slightly with subsequent heating. The coefficients of expansion from 15 to 1,000 deg. C. for the sample burnt to Cone 9 were 683×10^{-8} for the first heating, 646×10^{-8} for the second heating, and 596×10^{-8} for the third heating. Similar results were noted for the test pieces burnt to other temperatures before testing.

It was next considered desirable to repeat the preceding set of experiments with some other raw materials commonly used in the production of silica brick and a Welsh (Bwlchgwyn) quartzite was selected for this purpose. It was ground and sieved through a 20-mesh standard I.M.M. sieve, 3 per cent. plaster added as slip, moulded into shape, and dried. Summarising the results, the quartzite, on burning to Cone 06 (980 deg. C.), showed only a small permanent expansion and was still unconverted quartz. Firing to Cone 9 (nominally 1,280 deg. C.) converted part of the quartz into cristobalite, the conversion being considerably increased on burning for two hours at Cone 14 (1,410 deg. C.), and completed after a further heating at Cone 20 (1,530 deg. C.) for two hours. No evidence of the conversion of the quartzite into tridymite was observed. The conversion of the quartz into cristobalite brought about a larger expansion from 15 to 1,000 deg. after burning at Cone 14 or Cone 20 than after firing to Cone 06 or Cone 9. By far the greater part of the expansion, however, had been brought into the range 15 to 300 deg., the increase in length being small between 300 and 1,000 deg. This result bears distinctly on furnace practice. With bricks in which the quartz had been converted into cristobalite by hard firing, no strain and danger of fracture would result from fluctuations of temperature between 1,000 and 300 deg., after the temperature of 300 deg. had been once obtained, whereas with lighter burned bricks containing quartz, strain would result whenever the temperature fell below 600 deg. The large and rapid expansion up to 300 deg. for the material fired to Cone 14 and upwards emphasised, however, the necessity for slow and careful heating in the initial period if expansion strains were to be avoided. It may be mentioned that the contraction from 600 to 500 deg. C. for the quartzite before its appreciable conversion into cristobalite was not very different from the expansion observed in this range—a result very different from that obtained for the Meanwood ganister, plaster being used in each case as a binder.

Flint.

The differences noted between the expansions of specimens prepared in the same manner from Meanwood ganister and from the Welsh quartzite suggested the necessity of studying the changes produced by heating some other form of quartz in the presence of a lime bond. Flint was selected and a similar series of tests carried out. In the first experiment the raw flint was ground to pass a 20-mesh standard I.M.M. sieve as in the preceding experiments, but in the other tests in this series flint ground to flour as used in the pottery industry was taken, the flints having been calcined to 1,000 deg. C. before grinding. In each case 3 per cent. of plaster was used to bind the specimens. Summarising the results, it appeared that the flint with a lime bond was, on heating, converted with greater ease into cristobalite than either the Welsh quartzite or the Meanwood ganister, the change being almost complete at Cone 9 and complete at Cone 14. The Welsh quartzite also transformed readily into cristobalite, but not with the same facility as flint. In this case the change started at Cone 9, but was not completed until Cone 20. Meanwood ganister with a lime bond showed practically no trace of inversion at Cone 9, but the change started at Cone 14.

As regards commercial silica bricks, so far only specially prepared test pieces had been used. Experiments were now conducted on commercial silica

* Abstract of a Paper read, October 6, before the Refractory Materials Section of the Ceramic Society.

bricks, two of them being made from the Welsh quartzite referred to above by kilning at about Cone 16. Silica bricks of the same manufacture were also examined after use in coke ovens and steel furnaces. The first brick (Sample A) examined was one made from Welsh quartzite (Bwlchgwyn). A test piece was cut from the actual brick and examined. A very large coefficient of expansion was observed from 15 to 250 deg. C., followed by a considerably smaller, but regular, expansion to 550 deg. From 550 to 600 deg. C. the rate of expansion was considerably increased. A small coefficient of expansion was found between 600 and 750 deg., and from this temperature to 1,000 deg. C. there was a slight contraction. The large expansion up to 250 deg. could be associated with the transformations of much cristobalite, whilst the increased rate of expansion from 550 to 600 deg. would correspond with the inversion of α-quartz into β-quartz. Owing to the large expansion accompanying inversion of the cristobalite the expansion of the brick from 15 to 1,000 deg. was more than double that of a fireclay brick. It would demand slow and careful heating with no rigid ties when the structure was first heated, and would be a source of danger from cracking and opening-out of the brickwork if the furnace, etc., had to be let down below 300 deg. C. The specific gravity of the brick was 2.40. Microscopic examination of the powdered brick showed it to be a mixture of quartz and cristobalite with no tridymite.

Sample B was cut from a commercial brick prepared from the same quartzite as Sample A, but containing 25 per cent. of quartzite flour (98 per cent. passing through a 200-mesh sieve). Its expansion temperature curve was of the same form as that for Sample A, but its expansion from 15 to 250 deg. C. was greater than, and that from 550 to 600 deg. C. less than, was observed for the brick made without the addition of quartzite flour. This result agreed with that obtained for quartzite flour burned at Cone 9.

Sample C was from a brick made from quartzitic pebbles occurring near Bawtry (Yorkshire). The expansion of a test piece cut from this brick was very similar to those of the previous specimens up to 550 deg., *i.e.*, it showed a large expansion to 250 deg. such as might be explained by the tridymite or cristobalite inversions and a regular but smaller rate of expansion from 250 to 550 deg. At this stage a difference was observed, for no discontinuity between 550 and 600 deg. arising from free quartz was detected. Instead, the brick expanded fairly regularly to 900 deg., after which there was no further expansion to 1,000 deg. C. Apparently all the quartz had been converted into other forms of silica. The large expansion from 15 to 200 deg. would be explained by the presence of tridymite and cristobalite. The specific gravity of the brick was 2.35. Determinations of the refractive indices of the particles of the powdered brick showed it to consist chiefly of cristobalite mixed with a very small amount of tridymite and some material of refractive index greater than 1.503, probably silicates. No quartz could be detected in a microsection cut from this brick.

Silica Brick after 14 Months' Service.

A silica brick of the same manufacture as Sample A was next examined after fourteen months' service, at a probable maximum temperature of 1,450 deg. C., in a coke oven. On dividing the brick, four fairly distinct layers were noted. The innermost layer next the exposed face was greyish-black with large white grains clearly distinguishable, and a brownish-black outer crust. This layer was about 0.6 in. thick, and was followed by a one-inch layer of light brown material. The next layer was dark brown, 1½ in. thick, and was succeeded by a light-brown layer about 1 in. thick. This last part looked very much like unaltered brick. Owing to the cracks which had developed during use it was not possible to cut test pieces from the brick. It was separated into the four layers and separate test pieces were prepared from them. They were ground until they passed a 20-mesh standard (I.M.M.) sieve, 3 per cent. plaster added, the mixture wetted, moulded, dried and fired in a laboratory furnace until Cone 01 was just bending. It was necessary to see whether this treatment altered the expansion of material in any way. Accordingly the expansion of a specimen cut from an unused silica brick was compared with that of one prepared from the same brick powdered with the addition of plaster, as described above, and fired in the laboratory until Cone 01 was just bending. (Specimens made from the powdered used brick without this preliminary heating were liable to break under examination). The expansions of the two specimens were practically identical. It was, therefore, assumed that no appreciable error was introduced by preparing specimens from the ground material in the manner described. The expansion curve obtained for the material from the innermost black contaminated layer showed none of the breaks which one was accustomed to get from material containing quartz, cristobalite, or tridymite. The coefficient of expansion diminished slowly and continuously as the temperature rose. It was such as might be expected from a contaminated quartz glass, and the total expansion was only half that of the layers behind it. The results of microscopic examination by refractive index taken alone would suggest that about half of the material was cristobalite and half quartz and silicates of higher refractive index, but if that were so, the cristobalite and quartz had not exerted their characteristic effects in the expansion test. The composition of the material in the layer can be expressed empirically by the formula $R.O$; 0.4 Al_2O_3; 14.3 SiO_2. The outer crust which was obviously partially fused was, no doubt, richer in basic material including ferric oxide. The expansion temperature curves obtained for the other three portions of the brick were practically identical, and the actual expansion from 15 to 1,000 deg. C. was in each case almost the same as that obtained for the unused silica brick. The character of the curves, however, was somewhat different from that given by the unused brick. There was a rather more rapid expansion from 15 to 150 deg. and practically no sudden expansion at 550 to 600 deg. Above 600 deg. also the specimens continued to expand, whereas the unused silica brick contracted slightly above 700 deg. C. It would seem that the long heating to which the brick had been subjected had completely transformed the original quartz of the brick. The refractive index of the material of these layers was almost throughout less than 1.503 and greater than 1.481, so that the microscopic examination declared them to be cristobalite associated with a little tridymite and quartz or silicates of higher refractive index. The difference in the expansion between the outer darker layer and the remainder of the brick demonstrated one cause of wearing of the brick in use. The expansion from 15 to 1,000 deg. C. of this darker layer was only about one-half of the rest of the brick, so that fluctuations of temperature would cause great strain to be set up between these two parts of the brick, with the consequent cracking off of the inner darker layer.

Commercial silica bricks made from the same Welsh quartzite were examined after twelve weeks' use at a probable maximum temperature of 1,600 to 1,650 deg. C. in the roof of an open-hearth steel furnace. On splitting, each brick showed four fairly distinct layers.

(1) A test piece was cut from the innermost layer next the face exposed in the furnace and highest in temperature, and examined in the apparatus. It expanded steadily from 15 to 240 deg., but from this point to 280 deg. a large and rapid expansion took place, so that the temperature-expansion graph was almost parallel to the expansion axis. From 280 to 630 deg. the rate of expansion was less than from 15 to 240 deg. No discontinuity in the expansion was detected at 550 to 600 deg., such as would be expected if free quartz was present. The coefficient of expansion above 630 deg. continually decreased until no further expansion occurred between 900 and 1,000 deg. The large expansion from 240 to 280 deg. was reversible on cooling, but occurred at a lower temperature (220 to 200deg. C.). It was presumably due to the α to β cristobalite inversion. Apparently neither quartz nor tridymite was present in quantity. Microscopic examination showed that the bulk of the material was cristobalite, having a refractive index between 1.503 and 1.481. About one-eighth of the powder had an index of refraction greater than 1.503 and probably consisted of silicates. A small quantity had a refractive index less than 1.481 and was probably tridymite.

XUM

The expansion of a test piece cut from a silica brick had already been compared with that of a sample prepared from the powdered brick, and no appreciable difference had been found. It was considered wise, however, to test this point again by comparing the expansion of the test piece cut from the hot layer of the brick from the roof of a steel furnace with that of one prepared from the powdered material. The substance was passed through a 20-mesh standard (I.M.M.) sieve, mixed with 3 per cent. plaster added as slip, moulded and dried. It was then heated in the apparatus to 1,000 deg. C., and the expansion curve for the second heating taken. It was almost identical with that obtained with the test piece cut from the brick, again justifying the use of the powdered material. Owing to the difficulty and almost impossibility of getting test pieces free from cracks from the brick, the experiments with the other layers were performed with test pieces prepared from the powdered brick.

(2) A test piece from the second layer of the brick used in the roof of a steel furnace expanded quite differently from the hottest portion. Its length increased steadily and at a fairly rapid rate to 300 deg., after which the rate of expansion decreased gradually with increasing temperature until there was a slight contraction between 900 and 1,000 deg. The cooling curve was similar to the heating curve. No marked discontinuity occurred. The total expansion to 1,000 deg. was about four-fifths, and that from 15 to 300 deg. C. about three-fifths, of that of the hottest layer, again showing the possibility of strains and cracks developing owing to the different rates of expansion of the two layers. Examination of the powdered sample showed about half the material had a refractive index greater than 1.503, that of the other half being between 1.503 and 1.481.

(3) The total expansion from 15 to 1,000 deg. C. of the third layer was not very different from that of the second layer, but the form of the curve was somewhat different, and there was evidence of the α to β quartz inversion. The microscopic examination of the powdered material gave similar results to those obtained for the second layer, but taking these in conjunction with the expansion of the test piece it seemed probable that some quartz and less silicates were present along with cristobalite in quantity.

(4) The expansion of the test piece from the fourth layer of brick used in roof of steel furnace did not differ appreciably from that of the unused brick, and microscopic examination of the powdered material immersed in oils of known refractive indices also gave similar results to those obtained for the unused bricks, *i.e.*, this layer consisted of a mixture of quartz and cristobalite with a very small amount of tridymite. The examination of a similar brick after use in the roof of a steel furnace has been described by Mr. C. S. Graham. His conclusions were similar to those reached by the present experiments.

A silica brick of the same manufacture was tested after use in the gas-port of a steel furnace for twelve weeks. The lines of demarcation between the different zones were much less marked than was observed in the brick from the roof of the furnace, as would be expected from the conditions of heating. The brick was divided into three layers. The expansion-temperature graphs of the hottest and middle zones were identical. They expanded steadily and fairly rapidly to about 220 deg., when a large and rapid expansion occurred to 280 deg. After this temperature the rate of expansion was smaller, and above 600 deg. the coefficient of expansion decreased with increasing temperature until from 900 to 1,000 deg. C. the specimen contracted slightly. No evidence of the α to β quartz inversion could be detected. The third layer expanded similarly, but the actual expansion was slightly greater. In each case the large and rapid expansion between 220 and 280 deg. was reversible on cooling, but occurred 20 to 30 deg. C. lower than on heating. In each case examination of the powdered material showed that about two-thirds of it had an index of refraction between 1.481 and 1.503 and was cristobalite, the remaining one-third having an index of refraction greater than 1.503. In view of the data from the expansion curves the bulk of this probably consisted of silicates.

Book Reviews.

Iron Foundry Practice. By George J. Pitt. Published by Cassell & Company, Limited. Price 6s. net.

The author of this excellent treatise, which is one of Cassell's Workshop series, is the lecturer on iron founding in the mechanical engineering section of Sydney Technical College, New South Wales. The book contains 257 pages, and is divided into 21 chapters. The subjects they embrace are materials used in iron moulding, green-sand moulding, core-making, core-drying ovens, pattern plates and machines for moulding, chilled castings and metal moulds, burning and casting-on moulding boxes, ladles, calculating weights of castings and estimating casting pressure, dry-sand and loam moulding, properties of cast iron, crystallisation, expansion and contraction in cast iron, fans and blowers, cupola construction and management, fuels and their preparation, and the question of heat in melting cast iron.

The book is essentially practical and technical in character, the academic side not being dealt with. It is illustrated with 65 original drawings.

A most interesting chapter is devoted to contraction in cast iron, and outlines, an original research carried out by the author at the college with which he is associated.

The information contained in the book is just that which should be held by every foundry foreman, and we hope Mr. Pitt will prepare a more advanced treatise suitable for the foundry manager, in which such questions as foundry design, costs, and organisation, and the more theoretical subjects are dealt with.

As a text-book for foundry apprentices, the work is ideal, especially when supplemented by elementary courses in chemistry, physics and mathematics; for with these subjects mastered, the student should be able to follow easily and with benefit the technical side of his work as put forward by Mr. Pitt, who, though described as a lecturer, is obviously a practical man.

Comment on Practique la Fonderie. By Jules Duponchelle. Published by Dunod, 47, Quai des Grands-Augustins, Paris, VI. Price 52 fcs.

The author of this book is a practical man, having been a foundry manager and a professor of foundry apprenticeship courses. He divides his book into eight sections, which are again subdivided into numerous sub-sections.

The book has been specially written for the practical foundryman, and is, in fact, dedicated to his old shop-mates. The extent of the work will be gathered from the fact that there are 485 pages, illustrated with 405 figures.

The eight sections referred to above deal with the iron foundry; re-melting cast iron; the copper foundry; the art of founding; the art of pattern-making; foundry sands; moulding, fettling, and foundry organisation.

For the British reader, it is the section on foundry sands which is the most interesting, as it is in this direction where the Continental foundryman excells.

A commendable aim of the book is to interest the practical foundryman in his work so that he will not only carry out experiments himself but will follow more closely the results of other workers.

Metal merchants all over the country have taken exception to the sale of the Government's entire stock of scrap brass, which has been almost concluded by the Disposals Board to the British Metals Corporation, Limited, for the sum of £4,000,000. This sum purchases a stock of 180,000 tons of scrap, which makes the price per ton about £22, considerably under the present market price. A meeting of merchants and scrap dealers in London passed a resolution protesting against the sale and requesting that negotiations should be broken off, and traders in general be given an opportunity of competing. The meeting also resolved to ask Sir Howard Frank, Chairman of the Disposals Board, to receive a deputation. The resolution was signed by Mr. Malcolm Garnham, the chairman. A similar resolution has been passed at a meeting in Birmingham.

Moulding Hydraulic Rams.

By E. Longden.

These notes and sketches outline the operations and construction of moulding boxes necessary to produce cast-iron hydraulic rams and cylinders when similar in design.

At A, Fig. 1, is shown a ram casting in half section, and at B the pattern for its production. A 12-in. shrink and scum head is allowed for on the pattern. If the foundry possesses cast-iron machine plates only one half-pattern is needed, which will form both halves of the mould. The pattern would be located by dowelling to the iron plate and the boxes by guide pins. In effect, it is applying the principle of plate moulding in a modified way.

The castings are poured vertically; consequently much pressure is exerted on the bottom end of the mould, necessitating very strong and carefully designed moulding boxes. Fig. 2 illustrates the construction of the most suitable type of moulding box. Each half-box is made in two or more parts, according to length of casting, and bolted together. They can be used for other castings which are similar in form but not in length. Section C D shows the shape of the box bars forming a T head, partly boxing in the sand and helping greatly to resist the outward pressure of the fluid metal whilst pouring. Section A B gives a cross view of the upper part of the box, which runs for about two-thirds of the length, and Section E F shows in the bottom piece of the box an additional bar running vertically for about 6 ft. from the bottom end.

With a box so made and joint flanges machined and bolted at intervals of 12 in. the fear of a burst out or runaway is reduced to vanishing point.

Some founders use boxes with plain bars, backing the sand with plates, sinking the box to a considerable depth in a pit and ramming round with sand. It is a waste of labour and far from good practice.

The mould is made horizontally and is rammed very soundly. Stiff loam is worked on the pattern for about 3 ft. from the end which is the bottom side when casting, the remainder of the pattern is faced with core sand. For about half the length of the box, the bottom half, it is advisable to continue the filling and ramming with stronger sand than black sand. A mixture of half black and half core sand is recommended. The remainder of the box can be filled up with black sand which has been wetted with clay water. After peg ramming sufficient sand should remain above the level of the box for a thorough flat ramming; sand is scraped from the bars, leaving again sufficiently upstanding sand for a further and final flat ram which should bring the sand flush with the box. The sand is then washed over with a thin preparation of clay water. No pricking with the vent wire is needed or allowed. The most careful moulder will, from time to time, run his vent wire too near to the face of the pattern, creating the danger of a run out. As the ramming proceeds four gate sticks, shown in Fig. 3, are placed in each half-mould, so situated that the metal drops clear down the mould cavity. The distribution of the runners and risers is clearly shown in Fig. 4.

When dressing the mould the bottom portion is well studded with flat-headed sprigs to withstand the first blow from the falling metal. The surface of the mould is swabbed with a good thickness of blacking; it is slacked and washed over with gum water. After a thorough drying, and whilst still warm, the mould is again washed over with a thin solution of blacking and gum water.

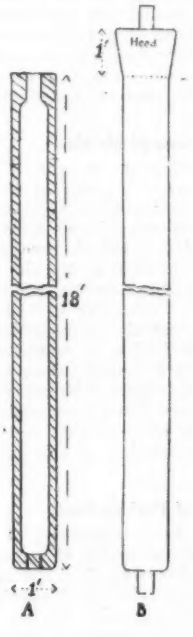


Fig. 1.

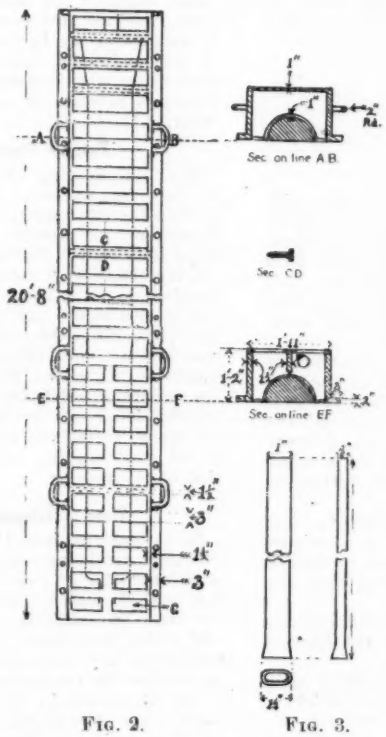


Fig. 2.

Fig. 3.

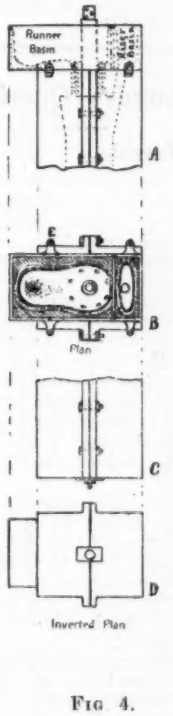


Fig. 4.

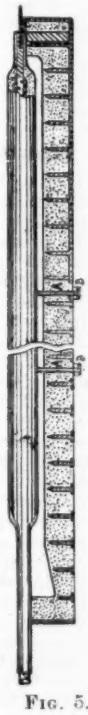


Fig. 5.

Fig. 5 shows longitudinal cross section of mould with the core adjusted ready to receive the top part. The core bar is solid for about 18 in. from the bottom and tapped to receive a stud-bolt used for fastening the core to the box. It is a safe way to secure the core, allowing at the same time freedom for the barrel to expand upwards. If secured at the top end, the barrel and core would bend, due to expansion, even whilst still pouring, and cause a waster casting. The wells of the casting must be very accurate. A bent core would also be indicated by a warped casting due to the lack of uniform shrinkage and, when solid, contraction. Obviously, such a long core will be slender and when placed in the mould will bend. No chaplets are permissible with this class of work. At AA, Fig. 5, are shown two temporary wooden chaplets, 2 in. dia., resting on plates bolted to the under-side of the box, and holding up the core. When the mould has been turned over to the vertical position, the chaplets are drawn out and the vacated holes plugged with cores, luted with loam, and secured by the plates BB. When the core is proved absolutely central, by checking with clay top and bottom, soft loam is run over the prints at both ends, and the top box again tried on to stamp the loam. The loam stamps are next dried with hot irons. With the mould finally closed, the space between the two end bars, shown at G, Fig. 2, which has not been previously filled,

is rammed with sand, the core bolted down, the joints stopped with loam, and the boxes tightly bolted together. If the height of the foundry will not allow the mould to be manipulated by one crane, two cranes must operate, one at either end, the one lowering in the casting pit as the other hoists.

Broken sections and plans of the mould when ready for casting are shown in Fig. 5. The elevation of the top end is shown at A, the plan at B, the bottom-end elevation at C, and an inverted plan at D. The last gives another view of the bolt and fish-plate securing the core. A runner and riser box is cast in one piece, the riser basin being separated from the runner basin by a bar. It is essential that the runner basin be dried. The runner and riser box is also secured to the main box by the lugs E. Stoppers are fixed and the mould poured.

Gated as illustrated, the metal is kept in an agitated condition, bringing scum and separated graphitic carbon well into the head metal.

A strong close-grained metal is used, having the following analysis:—Silicon, 0.9; sulphur, 0.08; phosphorus, 0.2; and manganese, 1.0 per cent. A low total-carbon content is desirable, but it is a little difficult to obtain.

Foundry Queries.

A Sand-Mill Trouble.

I have been having considerable trouble with sand lately. I am in a small way, making chiefly small light castings in iron, brass and aluminium.

To prepare facing sand I have a mill with fixed pan and revolving rollers, not the solid type, but cut away at the sides to resemble teeth, my idea being that these were superior to the solid ones, which roll the sand into a hard cake.

I was disappointed with the result, however, as the sand still cakes up on the bottom of the pan and the scrapers just rise up when the cake gets too hard, and do not scrape the bottom of the pan. The result is that when I open the delivery door to discharge the sand I only get out a small quantity, the bulk being caked on the bottom of the mill.

I have readjusted the scrapers continually, but after a few turns either the scrapers are twisted round out of action, or if they do manage to remain in position the cake is so hard and firm that the belt slips and the mill stops.

I am continually having the belt tightened up, and have had the speed reduced with the idea of obtaining more power.

The trouble still remains, and the result is that I get very little sand out of the mill, which is supposed to be self-cleansing.

Moreover the sand does not get mixed and toughened up as it should be, and requires to be riddled through a fine riddle to break up the lumps, and even then there is a considerable amount of riddling, consisting of hard pellets of sand. A fine sieve even allows some of these pellets through, which roll against the sides of patterns and cause a rough surface. Drier working seems to improve this, but obviously the employment of this method is limited.

I am told to get a centrifugal machine to break up the sand after going through the mill, but this is extra expense for my small place, and I consider that it is some defect in my machine which calls for improvement.

Perhaps other foundrymen have experienced the same trouble, and have overcome it.

Meanwhile my mill remains, apparently, a good machine, but incapable and inefficient, and some of the men, when they want tough sand, resort to the hard wood toughener, working up a small quantity at a time on the bench, and each consignment of new sand disappears rapidly.

I shall be glad of some of your readers' opinion on the matter.

Anxious.

Nearly 2,000 men employed by Guest, Keen & Nettlefolds, Limited, resumed work at Dowlais Steel Works last week. They are engaged on tin bar work on day-to-day contracts.

American Research Work.

According to the report of the Committee of the Privy Council for Scientific and Industrial Research for the year 1920-21, the United States Government will spend 90 million dollars during the present year on research work.

Under the auspices of the Division of Engineering, committees have been formed to carry out research work on the following subjects, and in some instances have completed their tasks:—

Physical changes in iron and steel below the thermal critical range; pyrometry; substitute deoxidisers; alloy steels; helmets and body armour; Neumann bands; manganese saving; steel ingots; hardness testing of metals; elimination of sonims of steel; high speed tool steel; core losses; highway engineering

The Division of Engineering has succeeded in achieving a considerable degree of co-operation between industries, universities and industrial research workers in the conduct of investigations of fundamental and commercial problems. The funds required for undertaking specific researches come from the interested industries; contributions in some cases are in the form of part-time services of staff engineers, laboratory facilities or material needed for the investigations. The following are examples of research carried out on a co-operative basis:—

Fatigue Phenomena of Metals.

The Engineering Foundation of the United Engineering Society has made a grant of $15,000 a year for two years for research on the Fatigue Phenomena of Metals. The experimental work is being done at the University of Illinois through its Engineering Experimental Station under the joint auspices of the Division of Engineering, Engineering Foundation, and the University of Illinois. The Univerisity furnishes certain services, laboratory space, and other facilities, a contribution equivalent to about $6,000 a year. Subsequently the General Electric Company agreed to contribute an additional sum of $30,000 for an extension of the work, to include 3 per cent. and 3½ per cent. nickel steel, placing no restriction on the publication of the results.

Head Treatment of Carbon Steel.

Investigations into the heat treatment of carbon steel are being carried out under the auspices of a committee of the Engineering Division of the National Research Council. The steel specimens for these investigations are provided by one firm and rolled into round bars by another. The heat treatment and some microscopic examinations are carried out by the chairman of the Committee (Dr. Henry M. Howe) in his private laboratory without pay; other microscopic examinations are made at the University of Minnesota, and magnetic tests at the Bureau of Standards. Grants towards the cost of the work are made by the Bureau of Standards and the Bureau of Mines. The machining of the test pieces is done by the Bureau of Mines and by four different firms without charge. Mechanical tests are made at Government institutions (Bureau of Standards, Watertown Arsenal).

The valuations of 18 Lanarkshire steelworks have been considerably reduced by the Appeal Court in Glasgow. The Court found that valuation should be based on capital values, applying in the following percentages: Ground 5 per cent., buildings 7 per cent., railways 5 per cent., furnaces 10 per cent., machinery 7½ per cent. The modification of the assessors' valuation was fixed at 30 per cent. The Mossend steelworks of Messrs. Beardmore, valued at £39,000, were revalued by the Court at £36,000, less 30 per cent., which makes the valuation £25,000.

A British standard specification for tramway axles has now been published by the British Engineering Standards Association. This specification is as follows:—A percentage of .05 of phosphorus or sulphur is permitted in the steel as in the case of the railway axle specification, but for the manufacture of tramway axles no particular process of steel-making is specified. Falling weight, tensile, and cold bend tests are required, the last being for use only where the order is for a number of axles under 15, when it is to take the place of the falling weight test.

Constructing Patterns to Favour Mouldings.—II.

By Joseph Horner.

Loose Pieces.—The fitting of loose pieces on the sides of patterns, or of coring, has been to some extent anticipated by the preceding remarks. The question often arises, and is determined by the facilities for withdrawing the loose pieces, and by the dimensions or complexity of cores. A loose

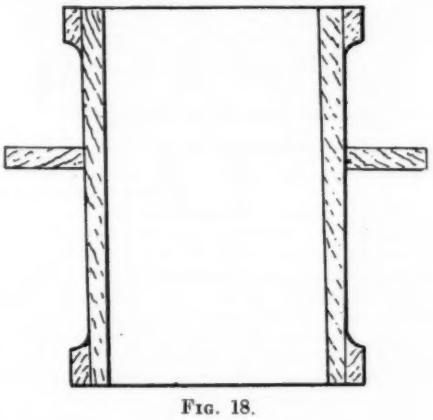


Fig. 18.

piece on the side of a deep pattern must not be so wide that it cannot be withdrawn laterally, entire, or divided into two thicknesses, into the mould. Here two cases occur. The space available may be that of a deep rib of no great thickness, or it may be a wide ample central space to be occupied with cores, which does not offer any limitations to the withdrawal of a wide loose piece. But even here it is not well to draw very wide flanges, bosses, or brackets inwards, even though their delivery offers little or no difficulty. The objection relates to the mending up and

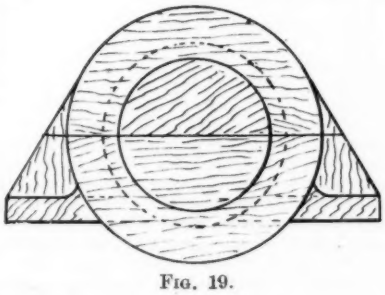


Fig. 19.

cleaning of the awkwardly-placed mould section, and sometimes to the difficulty of inserting cores. Much depends on width or area of the loose portion. Thus, a boss of large diameter is much less objectionable than a thin flange, or lug.

On the other hand, a covering core of large dimensions is not desirable, although it avoids the

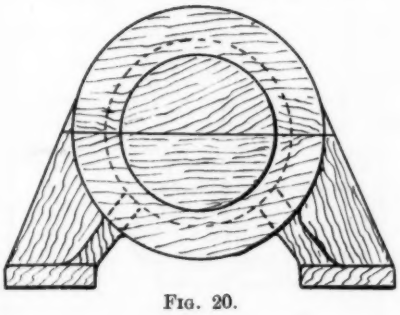


Fig. 20.

trouble of loose pieces, and is often used. The alternative then is to employ a drawback plate to carry the sand above the loose piece, or to include it also. This is a rather tedious method, and may conduce to slight inaccuracy in resetting the drawback. In making choice from these alternatives, the pattern-maker must exercise judgment. In many instances no question exists as to the best method to adopt. But other jobs are on the border line, in regard to which the views of pattern maker and moulder may be at variance.

In Fig. 18, the lower strips would be left loose,

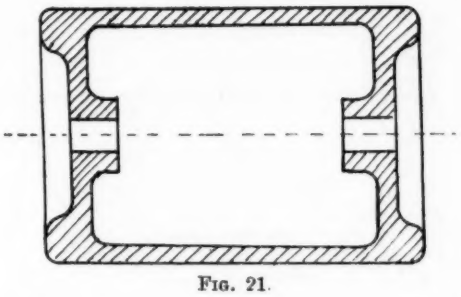
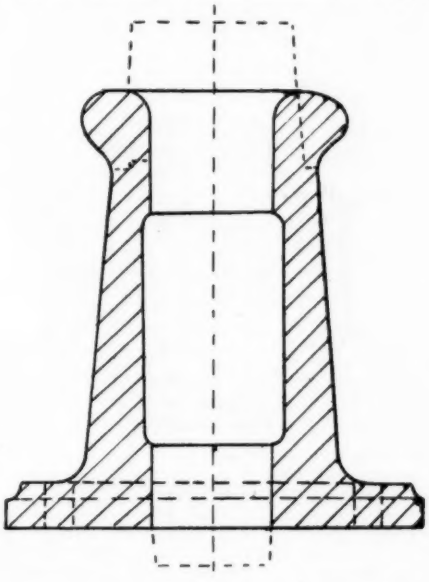


Fig. 21.

although they are deep down. But the strips above are too wide to be drawn-in readily, and they should either be cored over, or the sides of the mould taken away on draw-back plates. In Fig. 19, drawing-in is undesirable; in Fig. 20,



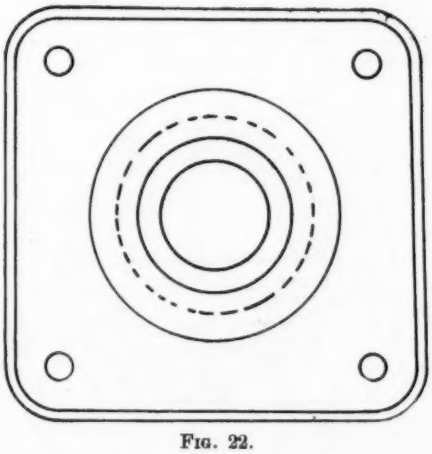


Fig. 22.

impossible. In both examples the better plan is to core over the feet. But drawbacks can be used.

The casting in Fig. 21, if moulded as it lies, horizontally, must have the projecting ends left loose, which is easily done, and would cause the moulder no trouble. But as the drum is short, it

is better to ram it with the axis vertical, when the mouldings can be permanent fittings. This is slightly more favourable also for setting the core for the interior. The buffer casting in Fig. 22 is moulded with the beading downward, left loose, two methods of jointing it being indicated.

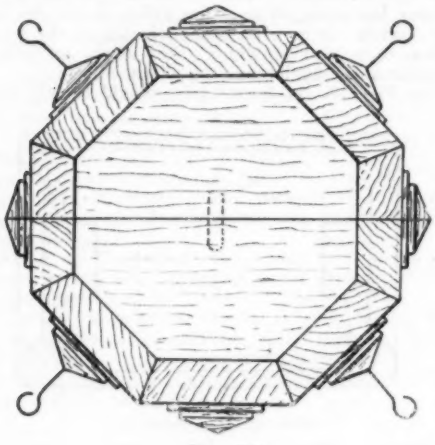


Fig. 23

This is done as being less troublesome to make thus, than to joint the pattern longitudinally, and set the core horizontally. The core standing with its axis vertically in the prints outlined is readily centred, and no joint mark or lap disfigures the casting.

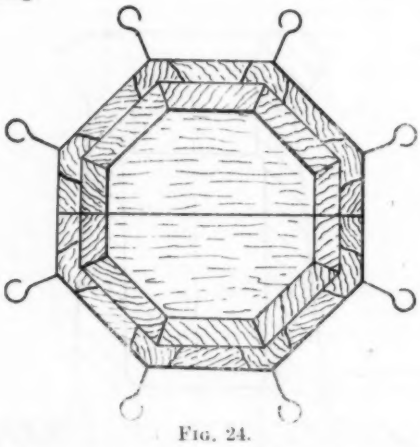


Fig. 24.

Loose pieces on the sides of patterns, to be drawn in, are shown in the column sections in Figs. 23 to 25. In the first, four bosses are fast, and four on the diagonal faces are loose. As they are circular, a single skewer, in the centre of each, suffices. In Fig. 24, strips are skewered on, all being necessarily loose. In Fig.

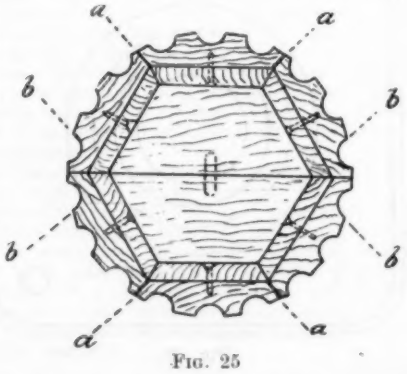


Fig. 25

25, flutes are shown with the directions of jointing for their delivery. The joints a, a, are not radial, but are parallel with b, b, which are the planes in which the flutes are not undercut. If this is present, the sand will be fractured during withdrawal. This determines the number of strips into which a fluted pattern must be divided. The deeper the flutes the more numerous must be the divisions. The side strips are withdrawn first, followed by those on top and bottom.

The fitting of loose pieces in copes relates to another class of conditions. These are left thus for

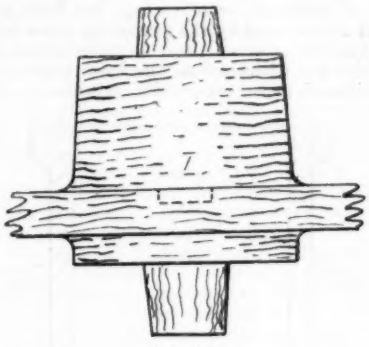


Fig. 26.

one reason only, to avoid fracture of the sand by the lifting-off of the cope from the pattern. It is preferable to leave deep pieces, and even those of moderate depth loose, to come away with the top sand, to be withdrawn after it has been turned over, than to pull the sand from off them. This is the general reason why patterns are jointed instead of being made solidly. The

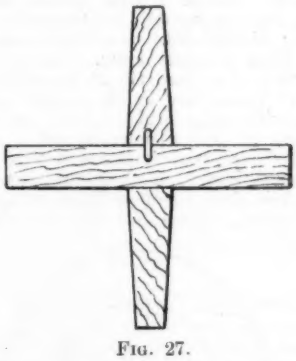


Fig. 27.

alternative is to put abundant taper in the portions that come in the cope, which may not always be practicable. Sometimes a flimsy pattern is made solidly rather than to joint it, and so preserve its maximum strength and stiffness. But when this is not necessary it is better to make top portions loose.

A boss and a rib are shown in Figs. 26 and 27. Each is deep enough to cause fracture of sand if

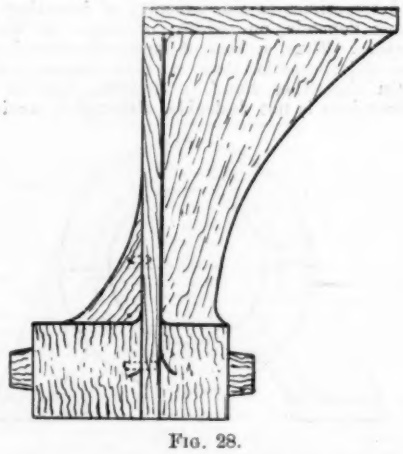


Fig. 28.

left fast. It will not occur if they are loose. The method is adopted in many details. The bracket in Fig. 28 has a boss and its rib loose. If made fast, either the cope sand would have to contain the entire boss and rib lifted off the pattern, or a sloping joint must be made, an awkward device,

leaving half the boss circumference in the bottom, and half in the top, with a nearly perpendicular joint very liable to crush when the mould is being closed Leaving the parts loose, a plane joint is

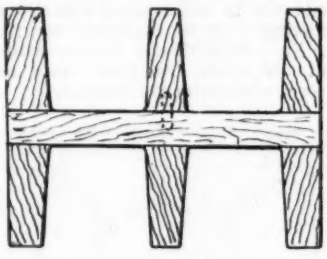


Fig. 29.

made along the top face of the web. This pattern might alternatively be divided at right angles along the central plane.

When a vertical rib occupies a central position, Fig. 29, there is even more reason for leaving it loose. In this case the flanking ribs are not loose. It is better to make them fast, and bring the joint along their top edges. The outside then has a straight lift. But considerable taper must be imparted on the inner sides from which the sand has to be lifted. Figs, 30 and 31 show incorrect and correct methods respectively for making deeply-ribbed

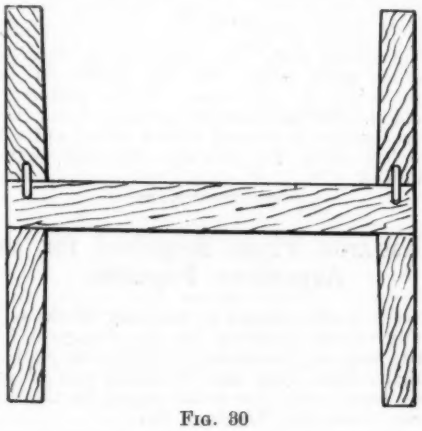


Fig. 30

patterns. The upper ribs should not be left loose. If they are, they may become rammed out of perpendicular, with no counteracting advantage. Made as in Fig. 31, the sand joint is carried along the top edges, the vertical outer faces deliver readily, and ample taper imparted to the inner faces enables a tolerably clean lift to be made there. Should slight fracture occur, the mould being plain, it can be easily mended. A pattern of this shape will always give a cleaner lift if the keen angles are filled with fillets or hollows.

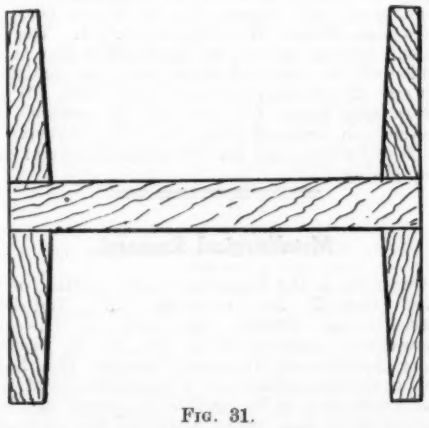


Fig. 31.

The broader question of main patterns being solid or jointed has wide possiblities, since it includes not only those of fair size, cast in iron, but the small patterns cast in large numbers by the brass founders, and many of those used in machine-moulding. The employment of undivided patterns in these cases, when practicable, not only conduces to the retention of their maximum strength, but also prevents risks of overlapping

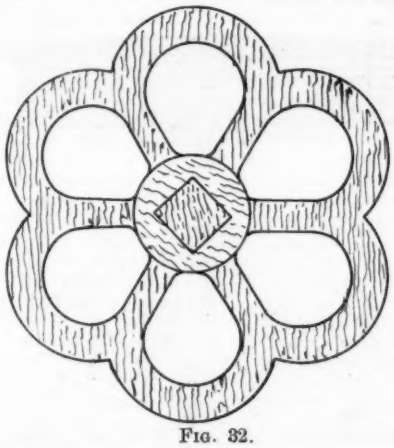


Fig. 32.

joints in the patterns consequent on the loosening of dowels in their holes.

The question of employing metal patterns or metal attachments in place of timber arises in the

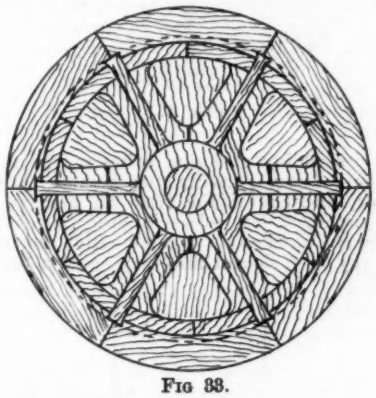
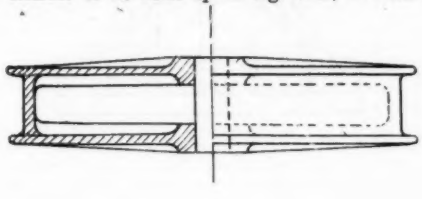


Fig 33.

case of many flimsy designs. To cut these from solid material is a sheer waste of time. They are too slender to be built up in segments, or with the



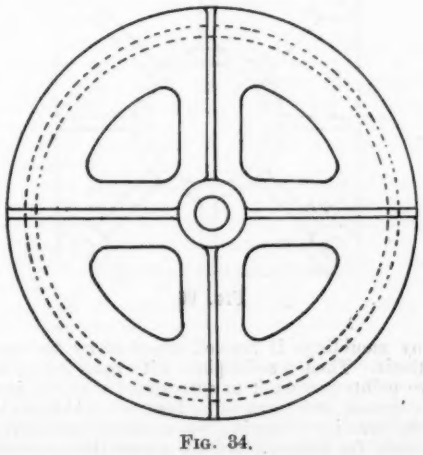


Fig. 34.

other methods suitable for patterns of larger dimensions. These are therefore made in metal by any rapid methods, as cutting in solid material to

stand one or two mouldings, or by coring, or tooling to shape from a chunk of metal. The hand wheel, Fig. 32, is an example which is typical of all the smaller hand wheels, and of many pump seatings and valves.

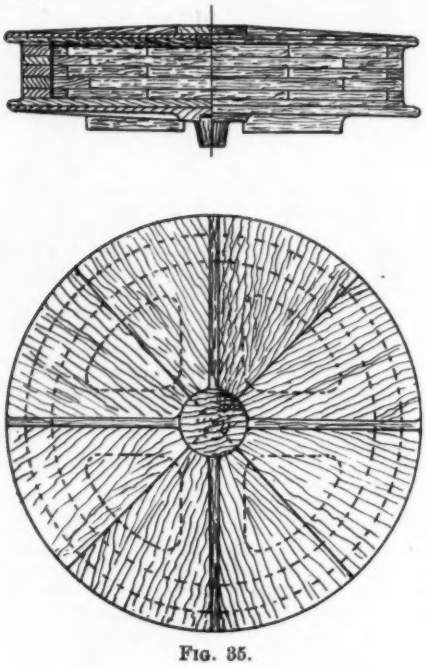


Fig. 35.

The desirability of coring arises in the case of some very flimsy patterns, not because coring is necessary and unavoidable from the point of view of the moulder, but solely in order to obtain a pattern of maximum strength and endurance. Arms may be so slender that they would not outlast

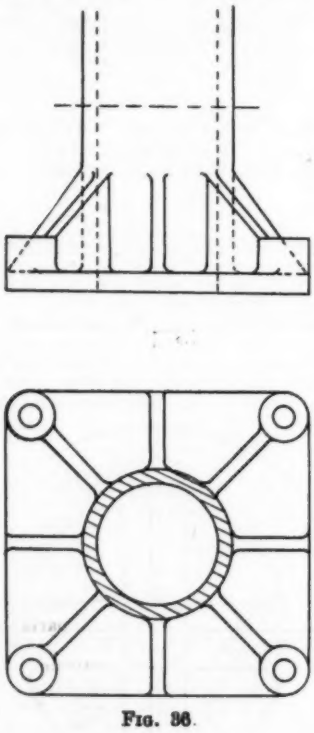


Fig. 36.

many mouldings if framed together by the usual methods. Then a solid plate with open joints may have prints put on it to correspond with the inter-arm spaces, and cores to be inserted. Akin to this is the practice of coring when alterations have to be made for different orders, alternative to cutting a pattern.

Fig. 33 illustrates a pattern of a sheave wheel with a central set of arms. If made in the ordinary way with arms locked together, it would have a short life. If solid-plated, as shown, and covered with prints, simple cores take out the inter-arm spaces, and the pattern will last a reasonable time. Fig. 34 is a light wheel for wire ropes, which could not be constructed strongly if made like its casting. It is, therefore, built up with segments, Fig. 35, with the bottom flange loose, and its interior cored. The four prints seen carry the four cores whch form the interior.

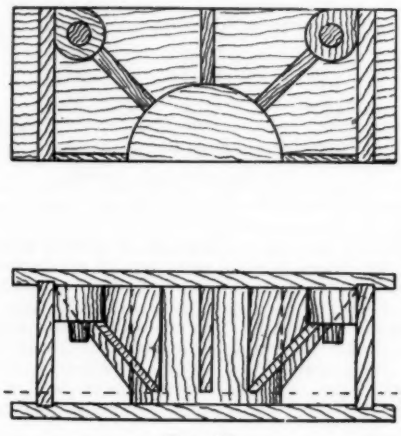


Fig. 37.

The column foot, Fig. 36, is strongly bracketed, and has thick bosses for the hold-down bolts. These might be put loosely on the pattern, but would involve the moulder in extra work. If the entire portion is covered with a print, and a half core box made, Fig. 37, the work will be much simplified.

Cast-Iron Pipes Required for the Argentine Republic.

The Argentine Board of Sanitary Works of the Nation invite tenders for the supply of 7,062 metric tons (approximately) of cast-iron piping of straight, light type and 88 metric tons of junctions, bends, etc., for water supply in the cities of San Juan and Buenos Aires.

Tenders are to be presented in Buenos Aires on October 19, on stamped paper and accompanied by a certificate of a deposit in the Bank of the Nation of 1 per cent. of the amount of the tender. Representation is essential in the Argentine Republic and the time limit renders it necessary for United Kingdom firms submitting tenders to cable their agents.

One copy of the specification and conditions of tender (in Spanish) have been received from the Commercial Secretary to His Majesty's Legation in Buenos Aires, and may be inspected by United Kingdom firms interested on application to the Department of Overseas Trade (Room 50a), 35, Old Queen Street, Westminster, S.W.1. The conditions contain articles which provide that (1) no tender will be admitted which contains conditional clauses, (2) sub-contracting is precluded, (3) tenderers may quote for part of the contract (4) tenders are accepted only from firms figuring on the Board's approved list of manufacturers of cast-iron piping.

Metallurgical Research.

According to the Report of the Committee of the Privy Council for Scientific and Industrial Research for 1920-21, the work on Dielectric Separation, commenced by Mr. H. S. Hatfield under the Tin and Tungsten Research Board, has been completed under the Department, and it is considered that it is possible a process has been evolved which may prove useful in the separation of minerals from their ores, or from one another, and may be capable of wide application.

Mr. Vivian is continuing his laboratory investigations on flotation, and one of these appears to be worth following up.

Foundry Reorganisation.—Part IV.

By H. W. J.

It cannot be said yet that all the preliminary work in connection with the reorganisation of the foundry is complete, for although it is less grimy than previously, and the offices are better appointed, there are still matters in the shop which need attention.

It is understood that the movements already advocated are not to please the fastidious, but that these have sound business attributes with which one cannot really dispense. And the same remarks apply to the propositions about to be put forward—they are indispensable to the interests of economical production.

The allocation of the floor area may be first considered, and this is more important than is at first apparent. The popular idea (and no doubt the correct one) is that the whole floor must be utilised. But for what?

Most of us have toured a foundry at one time or another, but it could only be accomplished with difficulty, on account of numerous obstructions. Walking, as popularly understood, was quite impossible, for here was a heap of sand to negotiate, there rows of moulds (in boxes) to step over, and, at certain times in the day, there were castings to negotiate, these being strewn about in a delightful confusion.

It may be urged that, at all events, the floor was being utilised, but the question arises whether it could not be planned to allow for walking space, and still reserve sufficient space for the actual needs of the founder.

When we visit an engineering factory, we find it a fairly simple matter to walk about freely, and yet get within close proximity to each and every machine. The machines are placed in rows on either side of a gangway, and yet it is never suggested that that gangway represents wasted floor space. On the contrary, it is most valuable, because the uses to which it is put help production.

It is not suggested that the foundry floor should be similarly planned, but the need for at least one (if not two) unobstructed gangways is obvious. It may be said that the overwhelming presence of sand is against this idea, but sand, like any other material, can be handled and confined as desired.

There should be no difficulty therefore in constructing a gangway; but the next question arising is in connection with its use. Many founders argue that it is superfluous, but, if nothing else, it is a time-saver. In the foundry, as in every other factory, much time is spent in walking, and as this is wasted time it is obvious that it should be reduced as much as possible. An unobstructed gangway assists in this direction, for if but a few seconds are saved on each journey, this mounts up in the course of a week.

Then, of course, there is the question of floor locomotion, for it is not always practicable for everything to be moved by overhead methods. No doubt an electric crane traverses the whole length of the building, and it is possible that there is also a light overhead runway. But in many foundries these are somewhat limited in their scope, and floor locomotion is an excellent auxiliary.

Travelling jib cranes and lever jack trucks can be used with advantage, heavy loads being transported quickly, and with a minimum of effort. These things cannot run over sand heaps and moulding boxes, and a firm, straight route is necessary.

Whilst on the matter of transit facilities, it is well to see that these are adequate, for if we are to expect increased production we must see that there is a sufficiency of materials, and also that the increased production can be handled. It is of no use producing that which we cannot get rid of, for subsequent efforts are necessarily retarded.

We must next see that the floor is properly sectionised, for without this it cannot be utilised to the best advantage. Much, of course, depends upon the construction of the building, and it may be that our foundry has not been designed upon modern lines. Still, we have to make the best of it, and in all probability some rearrangement may be necessary.

If there is more than one building, and both small and large castings are being handled, one building may be utilised for the large and one for the small. But, again, these castings may be various types, each necessitating different treatment. In Belgium the practice is, as far as possible, to separate the various types, and so we find one foundry set apart for the production of castings of a weight exceeding 5 lbs. and another for castings (both hand- and machine-moulded) below that weight, whilst still another foundry is engaged exclusively upon castings used in connection with the building industry, such as pipes, gulleys, gratings, etc., upon which machining operations are unnecessary.

Unfortunately, we have (for illustrative purposes) but one foundry (and this comprising but one building), and so it becomes necessary to sectionise it. It may be that our speciality is the small grey iron casting, produced in large quantities, but we are also open to execute orders for heavier castings, and so provision must be made for these.

It is important that we thoroughly understand the type of casting we are endeavouring to produce, and it is unwise to undertake too wide a range. The founder catering principally for the building trades too often does not understand the requirements of the engineering industry, and before embarking upon the catering for the latter industry it is well for him to give the matter careful consideration, otherwise the orders he receives in connection with the same may prove a curse instead of a blessing.

It seems safe to assert that the product of the average small foundry should be fairly uniform, and if the building trade provides the bulk of the orders, and other work is wanted, then the commodities required by the eastern countries—rice bowls and the like—should be catered for. But if we are engineers' founders, and our castings have to submit to machining operations, then that is the type of casting we must concentrate upon, with a view to producing the "cheapest and the best."

So, assuming that our castings are on the small side, although we are prepared to execute orders for a heavier casting of a similar type, the sectionising of the foundry must be in accordance with the need. In all probability, the majority of the small castings are machine-moulded, and this means that the centre of the floor can be reserved for the heavier castings, whilst the machines are lined up nearer the sides. This allows for the making of a definite gangway, which acts as a division of the sections, as well as a communicating and feeding medium

Our cupola is in an accessible position, and the core ovens are as well placed as the construction of the building will permit. The construction of a raw material store must engage our attention, for it is just as important for supplies to be checked into the foundry as for the finished product to be checked out.

It is important that this store be properly organised, and a correct record made of all materials passing into the foundry. Too often this store is nothing but a yard, into which material is dumped and taken away with impunity. No one, apparently, is responsible, and the wastage cannot be estimated.

It is not suggested that an elaborate, covered-in store is necessary, nor that all the parts should be under lock and key, but there is no reason why the materials cannot be systematically stored and classified. Bunkers, or something similar, can be provided for the storage of coke, pig-iron and scrap, and in connection with the last-named, if this is purchased from outside sources, a careful classification is essential.

The position of the pattern store is determined largely by the procedure adopted in regard to patterns, for if there is a pattern shop in all probability the store adjoins, whilst if customers' patterns are used, the store forms part of the foundry group. The question of patterns will, however, be dealt with later.

XUM

The trimming shop deserves more attention than it usually receives, and its situation should be as near as possible to the point of dispatch. The minimising of hand labour here is essential, and with the mechanical devices now upon the market this should not be a difficult proposition. The rumbler, rattler, or fettling drum (whichever name it goes by) has been in evidence for long, but the rumbler sand-blast is a more modern contrivance which is gaining in favour. The sand-blasting of castings is insisted upon by many engineers, as the clean finish makes it possible to estimate machining rates with accuracy.

Adjoining the trimming shop should be the finished part store and dispatching department, and a check must be made upon all castings received in. These should pass inspection before being received, and an inspector's report should accompany each batch. It should not be possible for obviously scrap castings to be dispatched to the customer (even inadvertently), for they should not be permitted to enter the store.

Not long ago the writer had occasion to return 400 castings out of a batch of 600, for reasons apparent to the most casual observer. The foundry manager, upon his next visit to the factory, was taken to task, and frankly admitted that he knew before castings left the foundry that a large proportion were scrap, but that they had "escaped in error." Errors of this description are likely to be expensive, for no buyer will tolerate such a thing. It is only fair to add that the defaulting foundry was not British, but it was a foundry which, to all appearances, was well organised.

A real inspection of castings before leaving the foundry seems to be the exception rather than the rule, and our foundry cannot be well organised until the inspection section is developed. We want to attract customers—not repel them—and if our customer has to spend much money inspecting every casting received in his factory, and then be put to the trouble and inconvenience of returning a high percentage of rejects, he will want to change his supplier.

So when the customer, or prospective customer, calls, we must show him our inspection section, and satisfy him that we are desirous of giving him good service.

Ferro-Vanadium.

From an Occasional Correspondent.

Some time ago the writer visited the works of the Vanadium Corporation of America, which are situated at Budgeville, near Pittsburgh, and saw the new electric furnaces working ferro-vanadium. There are three furnaces, a small one in which the metallurgist, Mr. Sakatwalla, worked out the process, and two large ones which measure about 20 ft. long by 10 ft. wide by 8 ft. high. The hearth of the furnace is built of blocks of carbon and the electrodes are of graphite 12 in. in diameter. The ends of the electrodes project into the slag lying on top of the fused metal, and the slag acts as an electrical resistor. The temperature attained is about 2,000 deg. C. The roof is built of special bricks made from Missouri flint clay. It is very thoroughly water-cooled. Two holes in the roof admit ore and slag materials to the hot zone between the electrodes, and two flues connected to the chimney take away the gases.

A novel feature of the furnace is that it is supported on two sets of rollers, by which it can be rolled away to one side so as to enable a newly-lined furnace to quickly take its place.

Ferro-vanadium, as made in the furnaces, contains about 33 per cent. of vanadium. This alloy has a much lower melting point than pure vanadium. The ore comes from Mina Ragra, in the Andes Mountains of Peru, at an elevation of 16,000 ft. There are six mining claims, four of which have each an area of 600 acres, and the ore reserve is estimated to be 28,000,000 lbs. of contained vanadium, sufficient to last 20 years at the present rate of consumption. The ore is a sulphite called patronite, which, in pure form, contains 19 to 25 per cent. of vanadium and 45 to 60 per cent. of sulphur, about 15 per cent. of the latter being free. It also contains some bituminous matter. It is self-burning, and before being sent down to the coast is roasted to get rid of some of the sulphur.

Although vanadium has been extensively prospected for all over the world, this Peruvian deposit is the only one that shows a good percentage of metal. The late Mr. James J. Flannery, of Pittsburgh, was the first to recognise the enormous possibilities of this Peruvian deposit of vanadium. He was originally an undertaker, and when he thought to buy the mines was only able to raise $20,000. He took half of this in gold to Peru, and when the owner of the mines seemed unwilling to sell, he poured the gold at his feet, and its glitter closed the deal. Within a day or two other foreign interests offered the Peruvian $200,000 for his mines, but fortunately for Flannery the owner had the Spanish ideas of honour and kept his word. In recognition of this, he was given one-tenth of the stock in the American Vanadium Company, which was formed to develop the mines. This represented $70,000 par value, and it paid dividends for ten years estimated at $320.50 per share, and the shares rose in value from $100 to about $1,000 each.

Until August of last year the output of the mines was carried on the backs of llamas to Lake Pun Ruyn and thence by Moreland motor trucks to the Cerro de Pasco Railway connecting with the port of Callao. As this journey could only be made in the dry season, deliveries were very irregular. A narrow-gauge steam railway, 12 miles long, has now been built from the mines to Lake Pun Ruyn, and a second railway is being made to connect the Lake with the Cerro de Pasco Railway. When this is completed there will be a through railway communication, and it will be possible to deliver ore all the year round and also to carry machinery and supplies up to the mines; at present this is difficult.

A 500-h.p. hydro-electric plant has been started which will give power and light needed to work the mines efficiently. At the water from the mine has a greenish colour due to vanadium contained in it, a dam and recovery plant has been built on the stream that runs from the mine, and it is estimated that much vanadium will be recovered.

A quantity of slag that was formerly thrown aside from the aluminium process is being used up. This contains only about 1½ to 3 per cent., but the electric furnace can extract even that low percentage.

The Vanadium Corporation supplies about 98 per cent. of all the vanadium used in the world, the rest being supplied by the Standard Chemical Company of Pittsburgh, which produces it as a by-product in the manufacture of radium, from carnotite ores of Colorado. About one-fourth of the total output goes to Sheffield, where it is alloyed with steel for making high-speed tools and for cutlery, etc. Considerable quantities of ferro-vanadium go to the Girod Works in France, which make electric steel, and before the war Krupps were large purchasers.

The production of ferro-vanadium in 1918 was 1,500,000 lbs. and in 1917 it was 2,000,000 lbs. In the year when the operations commenced, namely 1914, it was only 383,000 lbs.

Bauxite in British Guiana.—The bauxite industry in British Guiana, where extensive deposits have been found, made considerable headway in 1920, but at the end of that year the company found it necessary to postpone further operations owing to the temporarily decreased demand for aluminium

Extensions to the Hoskins Works.—Advices from Australia indicate that the extensions to the plant of the Hoskins Iron & Steel Works, Limited, on the South Coast, are well advanced, and it is estimated will result in doubling the output capacity of the works at Wongawilli and Dapto. At the former plant the existing 40 coke ovens have been in full operation, and work is in progress on the installation of an additional 30 ovens By the addition of improved types of coal-washing machines production of first-class coke from dirty coal is rendered possible. Each machine deals with 20 tons per hour, the motive power being electric. It is expected that the local coke-making industry will receive a considerable impetus by the construction of the cross-country line connecting with the Great Southern line, for contingent on such construction depends the erection of the big steelworks at Port Kembla by the Hoskins Company.

Some Notes on the Inherent Properties of Pig-Iron.

By J. Shaw.

I am sure it was not Mr. Young's deliberate intention to mis-state the views held by myself and others on the above subject. Unfortunately, that is the impression given in his article published in your last issue.

To clear the matter up I propose to tabulate our beliefs.

(1) We believe that if all conditions (including blast furnace) are identical, with the same analysis of your iron you will obtain the same physical results.

(2) We believe that having regulated our blast, weighed our charges, the right depth of bed, etc., in our cupola, so that we can depend on receiving metal at a high temperature and showing the same gain of sulphur and loss of silicon and manganese each blow we have stabilised our cupola practice as near as the rough and tumble of works practice will allow. Any irregularity of cupola working would be shown in the increased gain or loss of the above elements during melting. The fact that we obtain test bars having the approximate analysis required day after day proves this point.

(3) We believe that under the above cupola conditions and with test bars of the same size and moulded in the same manner, the mass action and cooling effects are the same day by day so far as these bars are concerned. This is borne out by the fact that when irons from the same stacks are used in the same proportions in the mixture for a period the physical results from the test bars do not vary much.

(4) We believe that due *purely to furnace conditions* irons do vary in their physical properties even when of the same chemical analysis. These irons do not return to their normal conditions under cupola melting. These irons are made at both ends of the scale of furnace operations, one type due to furnace scaffolds, etc., as mentioned by Dyer on page 265 of The Foundry Trade Journal. The others (those with very low silicons, yet grey in fracture) due to time and temperature effects in the hearth of the furnace. This latter view was agreed to by the present Director of Research and others when I tabled a sample at Prof. Carpenter's meeting at Dudley. Or to quote from a private letter received from another prominent metallurgist, "I have always felt that this change was due to one of two causes: either to some other element which had not been considered in the analysis, or else to extreme overheating at some time. I am inclined to think it is possible to overheat iron and destroy the relative relations between the attractions of various elements in the iron, so that when these elements cool together they come together in different relation than they normally would, providing the iron has been heated to the usual temperature. This, however, is only a theory of mine, but I think it could probably be borne out if some experiments were made in heating to extremely high temperature in an electric furnace."

I agree with Arnott that these extreme "freak" irons are rare, but I am equally sure that large quantities of iron just outside the normal are produced and so effect our high test results.

The tests in our present B.E.S.A. specifications are a compromise between buyer and seller. They are about the highest that can be regularly obtained under ordinary works conditions and approximate to about 12 tons tensile on a 1.128 in. dia. bar. In America, that land of universal chemical analysis, they are content with an 8-ton tensile for casting ¾-in. thick and under; 9 tons for castings between ¾-in. and 1¾-in. thick; 10 tons 14 cwt. for castings 2-in. thick and over.

While I agree with Arnott's view that it is wise to use several brands of iron in a mixture, does he not go further than I do by attributing special characteristics to irons of the same analysis from different furnaces, unless he considers these special properties are due to different furnace conditions rather than special ore qualities?

At the same time have not both these gentlemen evaded the point at issue, that is: How was it in the Cook and Hailstone investigation (we have all had these experiences, but they are not borne out by a separate independent chemist as these results were) when using irons from stacks, say, numbered 1, 2 and 3, in certain proportions; they not only obtained the chemical analysis they required, but time after time obtained a tensile of 16 to 18 tons with a network structure.

When using irons, say, numbers 1, 4 and 5, proportioned to obtain the same analysis, the tests dropped down to 12 to 14 tons tensile without the network structure. It will be noticed that the lower tests would pass the compromised specification. Are not most of us content if we do this without troubling why we at times obtain these higher results? I have offered one reason for this difference, but shall only be too pleased if a better can be proved.

With regard to the latter part of Mr. Young's article *re* pig irons, I cannot think that he appreciates the difficulties of the blast furnace manager. If Mr. Young cannot stabilise his cupola, where he knows the composition of his iron, coke, etc., is it reasonable to suppose that quite regular irons can be produced from a furnace working on a variable gangue, etc., when often the first notice of any irregular working is a change in the colour of the slag, and it perhaps means the reduction of a hundred tons of material before the alteration of burden then made comes into the melting zone. I hold no brief for the furnace manager, but I have some appreciation of his difficulties in producing a regular product.

Cleaning Steel Castings.

According to a recent issue of the "Edgar Allen News," one feature that has been highly developed in connection with steel-foundry practice is the cleaning of steel castings by a jet of air at high pressure, loaded with chilled iron shot. The Edgar Allen steel foundries are equipped with a large amount of this type of apparatus, and the treatment of the castings by this method is not only a general advantage to all the firm's customers, but is exceptionally valuable to those clients who require a casting from which every trace of sand has been removed; in fact, many of the articles produced at the Imperial Steel Works would be useless if they could not be thoroughly shot-blasted to remove all scale and sand.

As an instance may be quoted the case of castings which carry an oil well to hold a lubricant for a bearing. It will be obvious that under such conditions one small grain of sand could cause a great deal of damage, and that unless it were possible to buy a casting which was perfectly clean, the use of such an article would be condemned for that particular purpose. Generally speaking, many castings of intricate shape and design are produced which it would be impossible to manufacture were it not for the provision of the shot-blast apparatus, and there is no question that even where hand cleaning will meet the case, the casting is immediately improved in appearance by submission to the shot-blast.

Many foundrymen have raised an objection to the use of this type of apparatus on the ground that it shows up many small defects which otherwise would not be exposed, and which are simply eye-sores But the contention of the writer is that to expose any and every defect on a casting is desirable in order that the user may decide whether such defects are of importance or not. Further, it is only by such methods that a continual improvement may be made in the quality of the material produced.

Another great objection hitherto laid at the door of a shot-blast plant has been the amount of dust which is produced when in operation. This is certainly an objectionable factor from the point of view of the workmen concerned, and although it is not claimed that the trouble has been entirely eliminated, there is no doubt that the efforts made by Edgar Allen & Company, in conjunction with the Adams Hydraulic Co., Ltd., have had the effect of vastly improving the conditions under which the operators perform the work. The apparatus adopted has been patented, and all those who find the shot-blast plant a necessity would do well to examine the methods employed at the Imperial Steel Works to overcome the dust trouble.

XUM

Trade Talk.

THE LILLESHALL COMPANY'S Snedshill forge and mills were restarted last week.

WILLIAM JESSOP & SONS have recently opened a new office and warehouse at Chicago.

ANCHOR SMITHS and shackle makers in the Cradley Heath district have agreed to accept a reduction of 6d. per ton on all forgings.

ABOUT 500 MEN employed by Walter Scott, Limited, at the Leeds Steelworks, have been temporarily suspended owing to lack of work.

A REDUCTION in the wages of the men employed by the Glamorgan Hematite Iron Ore Company at Llanharry has been agreed upon.

FULL TIME WORK was resumed in the Royal Dock yards at Portsmouth last week, but it is stated the discharge of 50 men weekly will continue for the present.

FOLLOWING TESTS AT LEEDS UNIVERSITY of iron ore found on the Grantley and Brimhare estates, owned by Lord Furness, geological experts have strongly recommended the continuance of boring operations.

THE WAGES regulated by the sliding scale under the Midland Iron and Steel Wages Board were reduced 5 per cent. from Monday, October 3, and this rate will remain in force till Saturday, December 3.

AFTER BEING IDLE for over twelve months the Swansea Vale spelter works are making preparations for an immediate restart. This will be the second Welsh spelter works to resume, the first being the Villiers, at Llansamlet, Swansea.

THE COMPLETION of the new blast furnace of the Bengal Iron Company, Limited, has been delayed owing to the recent coal strike, but the work is well in hand, and it is expected that the furnace will be in blast early in 1922.

AS A CONSEQUENCE of the strike in the factories and foundries at Roubaix and Tourcoing, the management of the International Agricultural Machine Company have decided to close for two months. About 700 workpeople are affected.

THE DIRECTORS AND SHAREHOLDERS of the Palmer Shipbuilding & Iron Company, Limited, have erected a cenotaph in the grounds of the Palmer Memorial Hospital, Jarrow, in appreciation of 1,543 employés who served in the war, and of 140 who fell.

A LAND LICENCE has been taken by the Parsons Marine Steam Turbine Company, Limited, from C. A. Parsons & Company, Limited, who have placed orders with the company for the manufacture of turbines, etc., for use in connection with land turbines

THE TRAFIKAKTIEBOLAGET GRANGESBERG-OXELOSUND, of Stockholm, Sweden, of the famous Kiruna iron mine, announce the appointment of Park & Williams, Inc., Philadelphia and Pittsburgh, as their agents for the sale of this ore in the United States.

AN ORDER for 200 four-wheels covered goods wagons for the Palestine railways has lately been divided by the Crown Agents for the Colonies between the Metropolitan Carriage, Wagon & Finance Company and the Gloucester Railway Carriage & Wagon Company.

UNDER THE sliding scale for the manufactured iron and steel trade of the North of England, wages will be reduced immediately by 25 per cent. The total amount of wage cuts this year is 132½ per cent., leaving the present wage scale 97½ per cent. above the standard.

IT IS NOW REPORTED that the Electrolytic Zinc Company of Australasia has completed a contract with the Board of Trade for the purchase, not for the sale as previously announced, of 750,000 tons of concentrates and slimes. The Board of Trade sustains a loss in the resale

THE RETURN OF LAUNCHES from the Wear shipyards during September is a better one than has been the case for some time, a total of six vessels with an aggregate tonnage of 19,348 having been placed in the water. In August there had been but one launch, whilst July was a blank.

AT MESSRS. CAMMELL, LAIRD'S shipbuilding yard, at Birkenhead, on October 1, the launch was successfully accomplished of the "Moldivia" a new mail passenger and cargo steamer for the Peninsular and Oriental Steam Navigation Company. The new steamer will accommodate 222 passengers.

THE STAVELEY COAL & IRON COMPANY, LIMITED, near Chesterfield, announce that the prices of their cast-iron pipes are no longer controlled by any Association, and in future they will quote independently of any other pipe founders. The company have recently extended their facilities for the manufacture of small diameter pipes up to 4 in.

A STATEMENT HAS BEEN issued by Armstrong, Whitworth & Company, Limited, from Elswick, with reference to the removal of Ministry of Munitions bonuses from wages in the engineering trade. It states that if means are not adopted to ensure fresh orders there will be greater unemployment during the next three months. A considerable number of orders had been suspended at Elswick owing to the high cost of production.

LAND ON THE west side of the new lock gates of the King George V. Dock at Silvertown, which belonged to the Port of London Authority, has, it is reported, been taken over by Harland and Wolff, Limited. Extensive ship repairing works are to be established.

THE members of the Spelter Manufacturers' Association met last week for the purpose of settling the basis of wages when work is resumed. It was agreed that this should be 50 per cent. above pre-war rates plus a bonus of 50 per cent., but as far as possible men will be paid by results.

THE OUTPUT of Scottish shipbuilding yards for September included 18 vessels of 54,652 tons. Of these 16 vessels of 50,152 tons were built on the Clyde; one, of 3,702 tons, at Burntisland; and one, of 300 tons, at Montrose. The Clyde total for the nine months amounted to 181 vessels of 350,016 tons.

GOOD PROGRESS HAS BEEN MADE with the construction of the United Steel Companies' plant at Templeborough for the strip and bar mills, and it is expected that this plant, with a capacity of 13,000 to 19,000 tons per month, will be finished by the end of this year. The extension of the Appleby Steel Works is proceeding, but is not yet approaching completion.

BRITISH BRIDGE BUILDERS submitted a tender of 977,680 gold pesos, and consequently have secured the tender to build the Santa Lucia River bridge in Uruguay. American and German firms submitted bids also, the American figure being lower than the German bid. The American quotation was 1,081,444 gold pesos, while the German bid was 1,084,595 gold pesos.

A LARGE SHIPMENT of locomotives from Elswick has been completed No fewer than thirteen locomotives, part of an order for 200 for the Belgian State Railways, have been brought from the Scotswood Locomotive Works of Sir W. G. Armstrong, Whitworth & Company, Limited, to Elswick, where they have been loaded on the Norwegian steamer "Belfri."

IT was announced in the King's Bench, on Monday, that the long-standing litigation between Admiral Sir Percy Scott and Messrs. Vickers, Limited, had been satisfactorily disposed of by the defendants agreeing to make a payment to Sir Percy to cover not only the royalties in question in these proceedings, but the absolute purchase of many valuable inventions which he had disclosed to the defendants.

MESSRS. VICKERS, LIMITED, have launched from their yard at Barrow the steamer "Hobson's Bay," built to the order of the Commonwealth line of steamers for trade between this country and Australia. Her engines will give a speed of 15 knots. The vessel will accommodate over 700 passengers, and has a big cargo capacity, with special machinery for dealing with Australian produce.

THE WALLSEND SLIPWAY AND ENGINEERING COMPANY, LIMITED, completed its 50 years' working record on October 2. The certificate of incorporation of the company dates from October 2, 1871. In connection with the jubilee of the firm, a brochure has been issued illustrating the various classes of work undertaken by them, and views of the works in the early days of the company.

SIR ALEXANDER KENNEDY, President of the Shipbuilding Employers' Association, gives an emphatic denial to the statements of trades unionists that British shipbuilders and shipowners are in collusion to stop shipbuilding with a view to forcing down wages. On the contrary, Sir Alexander says that shipbuilders are actually tendering for new tonnage without any hope of profit, and in some cases with assured knowledge that they will receive only 10s. for each 20s. expended.

Density of the Zinc-Copper Alloys.

BY T. G. BAMFORD.

The density of alloys is important, both from a theoretical and a practical standpoint. When the correct density is known, it is possible to determine whether casting conditions have been satisfactory. Hitherto no trustworthy determinations of the densities of the copper-zinc series have been available. The author, after reviewing earlier work, records experiments conducted with alloys made from pure metals, and cast in sand- and chill-moulds respectively. The results indicate that there is a contraction in volume (*i.e.*, increase of density) due to alloying with mixtures containing more than 25 per cent. of copper, and that the density of the sand-cast (or slowly cooled) alloys is generally less than is the case with the chill castings, but that at points where the liquidus and solidus coincide on the constitutional diagram, chill castings and sand castings give the same values. These results afford striking confirmation of the data published by Turner & Murray on the volume changes of the copper-zinc alloys.

Company News.

Coltness Iron Company, Limited. — Ordinary dividend, 6 per cent. per annum for year.

Palmer Engineering Company, Limited.—Capital £5,000 in £1 shares.

Tankers, Limited.—Payment of preference dividend deferred until final results are ascertained.

International Electrolytic Plant Company, Limited.—Capital £11,000 in 10,000 10 per cent. preference shares of £1 and 20,000 ordinary of 1s.

Bordesley Electrical Accessories, Limited.—Capital £5,000 in £1 shares. Registered office: 162, High Street, Bordesley, Birmingham.

Bell's United Asbestos Company, Limited.—Interim ordinary dividend 6d. per share, less tax.

Birmingham Small Arms Company, Limited.—Usual dividends for six months on A preference of 5 per cent., and on B preference of 6 per cent.

Fleming & Ferguson, Limited. — Profit, £20,716; balance dividend on preference shares, £1,500; further ordinary dividend, making 10 per cent., free of tax, for year; carry forward, £12,466.

Parsons Marine Steam Turbine Company, Limited.—Profit, £42,581; brought forward, £21,096; dividend, 20 per cent. per annum, free of tax, of which interim dividend 7½ per cent. for six months paid, £42,256; carried forward, £21,422.

United Steel Companies, Limited.—Income received from associated companies, £1,013,928; surplus on profit and loss account, £335,960; interim ordinary dividend, 3 per cent., less tax; no further ordinary dividend, but balance carried forward.

Bengal Iron Company, Limited.—Net profit, including £8,157 brought forward, £318,710; depreciation and colliery sinking fund, £28,264; taxation reserve, £54,000; general reserve, £16,168; preference share dividends, £37,496; ordinary dividend, 10 per cent. per year, £157,403; carry forward, £25,378.

Dalmellington Iron Company, Limited. — Profit, £38,270; brought forward, £7,514; depreciation and deferred repairs, £11,232; balance, £34,352; preference dividend, shareholders, 5 per cent.; ordinary dividend, 3¾ per cent., £10,237; final ordinary dividend, 9d. per share (making 7½ per cent. for year), free of tax, £10,237; carry forward, £7,577.

Palmers Shipbuilding & Iron Company, Limited. — Profit, £199,219; debenture and loan interest and redemption, £113,843; brought forward, £30,305; available, £115,681; interim dividends, preference and ordinary, 2½ per cent.; final preference dividend, 2½ per cent., making 5 per cent. for year; reserve against investments, £40,000; carried forward, £34,346.

Hurst, Nelson & Company, Limited.—Profit, £94,229; deduct depreciation on works, machinery, etc., £17,406; brought forward, £17,684; preference dividend, 6 per cent. per annum, less tax; for final preference dividend, reserve, £6,000; general reserve account, £20,000; dividend on ordinary, 2s. per share, free of tax; bonus, 1s. per share, free of tax; interim ordinary dividend, free of tax, £10,000; special reserve account for equalisation ordinary dividends, £5,000.

Gazette.

The Meta Engineering Company, Limited, are being wound up voluntarily. Mr. F. P. Barnes, Broad Street House, New Broad Street, London, E.C., has been appointed liquidator.

Trading in the style of Mitchell & Wray, Messrs. W. Mitchell and F. Wray, 22, Caledonia Road, Keighley, textile machinery repairers, have dissolved partnership. Debts by Mr. W. Mitchell.

Messrs. T. W. Haddon, A. W. Haddon, A. E. Arthur and G. E. Lambert, screw and rivet manufacturers, Moseley Street, Birmingham, trading under the style of Thomas Haddon & Company, have dissolved partnership, by the retirement of Mr. T. W. Haddon and Mr A. W. Haddon.

Improved Concrete Construction Company, Limited.—A petition for the liquidation of the company has been presented by Burn Brothers, 3, Blackfriars Road, S.E. Hearing, Royal Courts of Justice, Strand, October 18. Messrs. Braby & Waller, 5, Arundel Street, Strand, W.C., solicitors.

Tungsten in China.—The Chinese Ministries of War and Agriculture and Commerce have jointly discussed the draft of the Tungsten Mine Prospectus and Operation Regulations, and a Central Tungsten Bureau has now been established to bring them into effect. The ore will be disposed of in the interest of the Government by this Bureau. There was little development in the mining industry during 1920 The wolframite mines in the Kityang district, also at Hingling and Puning, have stopped production, on account of the low selling price of the ore.

Applications for Patents.

The names of communicators are printed in italic type. A new number will be given when the Complete Specification is accepted.

Beardsley, E. O., and Piper, W. F. Moulding-machine. 24,358. September 13.

Bedford, R. A. Manufacture of hollow steel or iron bars, shafts, rock drills, etc. 24,604. September 16.

Bignamy, J. B. Electrical circuit-controlling devices. 24,356. September 13.

Billingsley, P. L. Mechanism for driving tool machinery. 24,236. September 12.

Blunck, G. Power-transmission gears. 24,256. September 12.

Bonnaffous, C., and Bozonett, B. Profile-milling cutter. 24,338. September 13.

Bouverie, S. Pleydell-. Fuel-consumption indicators. 24,455. September 14.

Boving, J. O. Water-turbines. 24,321. September 13.

Brown, H., and Wilkinson, A. Wire-rope caps, and means for affixing and removing same. 24,451. September 14.

Caldwell, T. A. Mechanical chain-grate stoker links. 24,574. September 15.

Carruthers & Company, Limited, J. H., Johnstone, G. K., and Young, J. Valve-gear for steam distribution in duplex pumps. 24,316. September 13.

Carryatt, R. I. H. Variable frictional gearing. 24,457, 24,458, 24,459. September 14.

Castle, T. R. Rotary fluid-pressure engines. 24,148. September 12

Centrifugal Castings, Limited, and Hurst, J. E. Melting plant for cast iron. 24,703. September 13.

Clayton, H. F. Oil-burning furnaces. 24,217. September 12.

Coninck, M. de. System of rheostatic converter, and its application to speed regulation of synchronous motors. 24,468. September 14. (France, September 30, 1920.)

Constantinesco, G. Pumps driven by internal-combustion engines. 24,187. September 12.

Crow, J. Plate-shearing machines. 24,446. September 14.

Ewart, G. H. Elevating-trucks, etc. 24,282. September 13.

Flood, J. F. Motors and pumps. 24,603. September 16.

Gourlay, J. Valve-gear for steam distribution in duplex pumps. 24,316. September 13.

Grant, A. A. Distribution valve for direct-acting pumps. 24,306. September 13.

Hancock, L. J. and T. R. Electric furnaces. 24,240. September 12.

Hansen, H. C. Pouring spout, etc. 24,402. September 14. (Denmark, October 26, 1920.)

Heyes, J. H., and Smith, L. Chain scraper conveyors. 24,736. September 17.

Hutsel, H. Apparatus for moulding and casting. 24,169. September 12.

Jones, A. G. Metal for shaft bearings, etc. 24,685. September 17.

Soc. Anon. Le Nickel. Manufacture of pure nickel. 24,658. September 16.

Kloetzli, T. Tools for grinding twist-drills. 24,319. September 13.

Lawrance, W. Trollies for overhead-conductor electric tramways. 24,502. September 15.

Lawton, J. W. Gear-changing device for machinery. 24,382. September 13.

Personal.

The late Mr. William Jones, of 22, Beaufort Road, Edgbaston, retired brassfounder, left £17,531.

The late Mr. George Frederick Fitton, of Headingley, Leeds, iron merchant, left £29,735 (net personalty £27,984).

The late Mr. William Beckett, of Tapton House, Sheffield, principal director of Alfred Beckett & Sons, steel, file, saw and edge tool manufacturers, left £9,846.

Mr. H H. G. Mitchell and Mr. A. G. Vaughan-Lee have been taken into partnership by Messrs. Coode, Matthews, Fitzmaurice & Wilson, 9, Victoria Street, S.W.1.

Mr. Marmaduke Wardlow, head of the firm of Messrs. S. & C. Wardlow, steel manufacturers, Sheffield, was on Tuesday installed Master of the Ancient Company of Cutlers of Hallamshire

Mr. John A. Smeeton, of Smeeton-Wright Furnaces, Limited, 56, Victoria Street, S.W.1, is shortly paying a visit to South Africa. He is open to undertake commissions for a few firms during his visit there.

Mr. A. J. Hendin, who has been associated for many years with the Fairfield Shipbuilding & Engineering Company, Limited, Glasgow, has been appointed manager of the shipbuilding department. Mr. T. T Ottewill will continue to act as yard manager.

XUM

IRON AND STEEL MARKETS.

Pig-iron.

Movements in the pig-iron markets so far offer little encouragement of an early improvement in trade conditions, the past week indicating a continuance of the slackness of demand on the part of consumers, and a curtailment of export business, which has so long adversely affected furnace production. The position in the Cleveland market remains practically unaltered, the prevailing slackness in the foundry industry depriving smelters of one of their best outlets for iron of that particular quality, the small amount of business passing in castings being amply satisfied by the three furnaces at Tees-side now engaged in its production. The opinion expressed in market circles is that buyers might be induced to come forward more freely if they were assured of more stabilised prices, but with quotations steadily trending downwards, a cautious policy is evidently readily understood. Another factor of importance in the situation, the comparative cheapness of Continental iron must not be overlooked, the imports into Tees-side ports during September amounting to no less than 20,320 tons, as compared with 15 tons in the corresponding period of 1913, while in the eleven months ended September 30, 57,783 tons of pig-iron were imported compared with 1,080 tons in the corresponding period of 1912-13. Meantime, deflation of Cleveland iron prices is proceeding gradually, and while, in consequence of the restricted output, No. 1 and No. 3 Cleveland foundry iron are kept at 125s. and 120s. per ton respectively, with 5s. loading charges in case the iron is for export, a weaker tendency has developed for all the lower qualities, and quotations are now No. 4 foundry 114s., No. 4 forge and mottled 112s. 6d., white 110s. All these latter prices represent a fall of 5s. per ton, and it is possible that even further reductions would be made for forge, mottled and white iron which the makers are anxious to unload.

The output of East Coast hematite now seems to exceed the demand, and makers are eager for orders at 130s. for mixed numbers, and 132s. 6d. per ton for No. 1. A fair quantity has been sold to South Wales, but the market abroad is extremely limited. The West Coast Hematite Pig-iron Makers' Association decided at a meeting last week to make a further cut of 10s. per ton in iron prices, and ordinary iron accordingly is quoted now at £7 5s. per ton, delivered at Sheffield, which roughly represents £6 8s. 6d. at the works.

Scrap.

There is very little fresh to report in connection with the scrap trade, which remains in a patchy condition, the stagnation in the foundry industry precluding any marked activity in business, and only occasional parcels of metal changing hands. These transactions are mostly in evidence when fairly favourable terms offer, but consumers, on the whole, already hold sufficient quantities of various kinds of scrap metal in hand to preclude further buying until a revived demand for their products justifies dealings on a more extensive scale.

Tinplates.

So far the further reduction in sheet bars to £8 5s. per ton has been almost ineffectual in stimulating demand for tinplates, makers contending that even at that price production at current quotations is still unprofitable. At the same time a few more mills are coming into operation in order to absorb the output of bars now that the steel works are being gradually restarted. Norway and Sweden are in the market, but so far not much business has resulted, and home consumers are also buying wasters and odd sizes. The former are becoming scarce. Generally foreign buyers are unable to operate owing to the high rates of exchange. Sales have been made in coke finish at 20s. 6d. basis net, f.o.b., but works are not keen on selling at this now, 21s. being the figure generally quoted for November, December. Spot plates are in moderate request, realising round 22s. basis for ordinary sizes. Wasters are in fair demand at 20s. for CW 14 x 20, 39s. for CW 28 x 20, and 15s. 9d. for CW 14 x 18¾, all net, f.o.t. at works. Sellers generally are quoting about 3d. basis over these figures. Light wasters are still wanted for the Far East; they are very scarce and command full prices.

Terneplates are very quiet; quotations are nominally 21s. 6d. basis for approved specifications, net f.o.b.

Finished Iron.

Manufacture in the various sections of the finished iron trade is still on a very curtailed scale, and although the Birmingham quarterly meeting last week was better attended than usual, the volume of actual business transacted was again disappointing. There were fair inquiries for marked bars, and makers confidently anticipate sufficient orders to keep mills running on the present scale of operations for some time to come, but the market for crown and the lower qualities remains quiet and depressed. As intimated in a previous report, Lancashire makers of crown bars had initiated a reduction of £2 in the basis price, and last week South Staffordshire and Yorkshire mills decided upon a substantial concession, including also marked qualities. Quotations for the latter now ruling £17 10s., 50s. lower, and unmarked £14 10s., 30s. down. The reduction of iron hoops in the Lancashire district to £17 10s. has made it difficult for Staffordshire makers to maintain the old rate of £20, which is no longer regarded as binding upon them pending formal adjustment. Scottish bar-iron makers report very little improvement. They have had a little more tonnage put before them lately, but this is due more to deliveries from the Continent becoming so uncertain. The export trade shows no improvement. At Sheffield a moderate volume of business is passing in bars, but users are under the impression that there will be a further revision of quotations before long, and in consequence are disinclined to place more business than is imperative. Yorkshire bars are now quoted 30s. down at £14 10s. per ton.

Steel.

The acute depression experienced in the various branches of steel production of late is happily showing signs of lightening to some extent, and though still affecting several of the more important sections of the trade can at least be assumed as having passed through the most critical stage of its development. This welcome change in the conditions of the industry has unquestionably been accelerated by the steady reduction in productive costs of steel manufacture as witnessed in the gradual decline lately indicated in the returns of the average realised prices of bars and angles produced by the firms affiliated to the Board of Conciliation and Arbitration for the Manufactured Iron and Steel Trade of the North of England:—January and February, £26 19s. 7.97d.; March and April, £24 1s. 1.48d.; May and June, £19 3s. 8.19d.; July and August, £16 13s. 4.77d. The process of deflation of values has been accompanied by a corresponding decrease of wages, regulated by a sliding scale arrangement as follows:—January 31 5 per cent., March 31 25 per cent., May 30 30 per cent., August 1 47½ per cent., September 26 25 per cent. Sheffield manufacturers of semi-products have consequently felt justified in making a further cut of £2 per ton on their quotations for acid billets and £3 per ton on file steel billets. The new prices are £13 10s. for Bessemer acid billets, £14 for Siemens' acid billets, and £16 for file steel billets. There is a free market for soft basic quality, the quotations for which vary from £7 15s. to £9. Crucible steel firms are doing a little better here and there. Although the reduction in wages did not afford very much relief to the industry, the partial reversion to three heats a day has spelt a great difference in establishment charges. Heavy engineering firms are also doing well in the matter of steel works equipment, for British firms chiefly, but also for export. The Brightside Foundry and Engineering Company has been well employed in this class of business, the company having just completed a big rolling plant for Hadfields, steel works plant for the Appleby Iron and Steel Company, and for Sheffield Steel Products. Conditions in the Scottish steel trade are extremely unsatisfactory, with business merely of a hand-to-mouth character, and some producers are finding it so difficult to carry on at present that they will probably determine to close down. Business in steel sheets is very quiet, as prices are not yet on a competitive level, and indications of a coming improvement are not apparent, despite the fact that deliveries of Belgian and Luxemburg sheets are retarded in consequence of labour troubles there.

Metals.

Copper.—The week's markets for standard copper opened with a slight reaction from the previous closing figures, the demand again proving disappointing and buyers evidencing considerable caution in dea'ings. Towards the close an easier tendency was developed, October dates selling at £69 12s. 6d. to £69 7s. 6d., and November £69 15s. Refined metal was again

firmer, with electrolytic advanced 20s., at £75 10s. to £77 10s., while wire bars were unchanged to 20s., higher at £75 10s. to £77 10s. Closing prices:—Cash: Wednesday, £69 7s. 6d.; Thursday, £69; Friday, £69 7s. 6d.; Monday, £69 5s.; Tuesday, £69 7s. 6d. Three Months: Wednesday, £70 5s.; Thursday, £70; Friday, £70 7s. 6d.; Monday, £70 5s.; Tuesday, £70 7s. 6d.

Tin.—Slightly more favourable Eastern advices imparted a firmer tendency in the market for standard tin, a cable report giving the selling price in Penang at £158 15s. c.i.f. influencing some hardening in values. The demand from actual consumers was, however, by no means brisk, but sellers of near metal were reserved, and on balance quotations improved for both positions. October dates were done at £156; December £157 10s. to £158 5s., and early February at £158 10s. English ingots closed steady at £154 to £155, and cash Straits at £156 10s. The weekly returns of tin stocks in London warehouses shows a decrease of 26 tons to 3,997 tons. Closing prices:—Cash: Wednesday, £156 15s.; Thursday, £156 10s.; Friday, £155; Monday, £155 15s.; Tuesday, £155 12s. 6d. Three Months: Wednesday, £157 15s.; Thursday, £157 15s.; Friday, £157 10s.; Monday, £157 15s.; Tuesday, £158 2s. 6d.

Spelter.—The market for this metal continues quiet but steady in tendency, the improvement in the galvanising trade, both at home and in America, influencing a more confident tone, and values were firmly maintained. October was done at £26 12s. 6d. and January at £27 2s. 6d. Closing prices:—Wednesday, £26 15s.; Thursday, £26 15s.; Friday, £26 12s. 6d.; Monday, £26 12s. 6d.; Tuesday, £26 12s. 6d

Lead.—The market for soft foreign pig is practically unchanged, a good turnover being reported at steady prices, October selling at £23 2s. 6d., November £23 2s. 6d. to £23, and December and January at £23. Business in English lead remains quiet. English closing prices:—Wednesday, £24 5s.; Thursday, £24 5s.; Friday, £24 5s.; Monday, £24 5s.; Tuesday, £24 10s.

IRON PIPES FOR CARDIFF.—The Cardiff Corporation Waterworks Committee recently considered tenders for cast-iron pipes. Amongst the firms who sent tenders were a French firm and a Belgian firm. The waterworks engineer (Mr. C. H. Priestly) pointed out that the tender by the Stanton Ironworks, Nottingham, was the most advantageous, and the Committee have accepted their offer of £4,594 6s.

Publications Received.

Messrs. Donovan & Co., 47, Cornwall Street, Birmingham, "Safuse and Donlock Gear."

"The Journal of Industrial Welfare," October, 1921, price 9d. 51, Palace Street, Westminster, S.W.1.

Messrs. Edward Le Bas & Co., London, Glasgow, Manchester and Belfast, "G.F. Malleable Iron Tube Fittings."

"The Journal of the Society of Technical Engineers," September, 1921. 102, Belgrave Road, London, S.W.1.

The Manchester Association of Engineers, 120, Pentland Street, Manchester, have issued a brochure setting forth the objects of the Students' Section, application for copies of which should be made to Mr. F. Hazelton, at the above address.

Dangers of Pulverised Coal.—Investigations of the U.S. Bureau of Mines have given rise to the following notes: (1) A small stream of pulverised coal leaking down from a defective joint in a coal transport line does not attract much attention, whereas a leak in a natural gas line under similar circumstances receives immediate attention. As a matter of fact, if by any means the dust cloud should come in contact with an open flame or hot metal, the effects would be as disastrous as if it had been gas. (2) One of the most serious troubles with which users of pulverised coal have had to contend has been the number of fires in the storage bins for pulverised coal. It has been somewhat difficult to determine the exact cause of these fires, but undoubtedly spontaneous combustion has played an important part in the origin of some of them. (3) Care should be taken that pulverised coal at a high temperature is not delivered to storage bins; and to avoid this, the gases of combustion from the drying furnace should not be allowed to become hot enough to overheat the coal. Storage bins for pulverised coal should not be placed in any position where they may become heated from furnaces, steam pipes, or hot flues. (4) If a plant has been shut down for several days, delivery of coal from the storage bin through transport lines to the place of consumption should not be permitted before an examination is made to ascertain whether the coal has become heated to a point that it will ignite when brought in contact with a current or blast of air.

Telegrams: "THROWER, GLASGOW." Telephone: 5909 CENTRAL.

ALBERT SMITH & Co FOUNDRY ENGINEERS. TOOLS & EQUIPMENT

Head Office: 60, ST. ENOCH SQUARE, GLASGOW.

SAND BLAST EQUIPMENT. For Any Service.

MOULDING MACHINES. Electric, Air & Hand Power.

FORCED DRAUGHT. Core Stove, Furnaces.

PORTABLE CORE OVENS.

CORE MACHINES. Core Compound. Core Oil. Glutrin. Parting Powder. Perforated Chaplets, Etc.

BRASS RECOVERY MACHINES. New Process.

XUM

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d
Standard cash	69	7	6
Three months	70	7	6
Electrolytic	75	10	0
Tough	69	15	0
Best selected	70	5	0
Sheets	103	0	0
India	103	0	0
Wire bars	75	0	0
Do. Nov.	75	10	0
Do. Dec.	75	10	0
Ingot bars	74	10	0
H.C. wire rods	83	0	0
Off. aver. cash, Sep. 68	0	11	13/21
Do. 3 mths., Sep. 68	18	11	1/2
Do. Settlement Sep. 68	0	5	5/11
Do. Electro, Sep. 73	4	1	1/11
Do. B.S., Sep. 70	0	6	3/4
Aver. spot, copper, Sep.	67	19	6
Do. Electro, Sep. 74	2	8	3/4

Solid drawn tubes 14½d.
Brazed tubes 14½d.
Wire 11d.
Yellow metal rods 7½d.
Do. 4x4 Squares 9½d.
Do. 4x3 Sheets 9½d

BRASS.

Solid drawn tubes 12½d.
Brazed tubes 15½d
Rods 11½d.
Sheets to 10 w.g. 11½d.
Wire 11½d.
Rolled metal 10¼d.

TIN.

	£	s.	d
Standard cash	155	12	6
Three Months	158	2	6
English	155	0	0
Bars	157	0	0
Chinese	153	0	0
Straits	156	10	0
Australian	157	10	0
Eastern	158	15	0
Banca	156	10	0
Off. aver., cash Sep.	156	17	6 13/21
Do. 3 mths., Sep.	159	2	1 5/21
Do. Sttlment. Sep.	156	16	7 1/11
Aver. spot, Sep.	67	19	6

SPELTER.

	£	s.	d
Ordinary	26	12	6
Remelted	23	5	0
Hard	17	5	0
Electro 99.9	34	0	0
English	nominal		
India	21	0	0
Prime Western	26	0	0
Zinc dust	45	0	0
Zinc ashes	5	0	0
Off. aver., Sep.	25	10	8 3/11
Aver., spot, Sep.	25	5	1¼

LEAD.

	£	s.	d
Soft foreign ppt	23	12	6
English	24	10	0
Off. average, Sep.	22	19	5 12/21
Average spot, Sep.	25	5	1¼

ZINC SHEETS.

	£	s.	d
Zinc sheets, spot	35	10	0
Do. V.M. ex. whf.	35	10	0
Do. ppt., t.o.b., N.Y.	—		
Dutch	34	10	0
Boiler plates	32	10	0
Battery plates	32	0	0

ANTIMONY.

	£	s.	d
English regulus	37	0	0
Special brands	42	0	0
Chinese	25	0	0
Crude	17	0	0

QUICKSILVER.

	£	s.	d
Quicksilver	9	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d
Ferro-silicon—			
45/50%	12	10	0
75%	20	10	0

Ferro-vanadium—
35/40% .. 21/- lb. va.
Ferro-molybdenum—
70/80% .. 6/6 lb. mo.
Ferro-titanium—
23/25%, carbonless 1/5 lb.
Ferro-phosphorus, 20/23%, £24
Ferro-tungsten—
80/85%, carbon free 1/6 lb.
Tungsten metal powder—
98/99% .. .. 1/9 lb.
Ferro-chrome—
4/6% car. £29
6/8% car. £28
8/10% car. .. £28
Ferro-chrome—
Max. 2% car. .. £78
Max. 1% car. .. £93
Max. 0.75% car. .. £110
65/75%, carbonless 2/8 lb.
Nickel—99·8%, cubes or pellets .. £190
Cobalt metal—97%.. 14/- lb.
Aluminium—98/99% £115
Metallic Chromium—
98/99% .. .. 5/6 lb.
Ferro-manganese—
76/80%, loose .. £16
76/80%, packed .. £17
76/80%, export .. £14
Metallic manganese—
98/99%, carbonless 2/8 lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	3	0
Finished bars, 18% tungsten	3	9

Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Flats under 1 in. by ⅛ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness .. .. 3d. lb.
Bevels of approved sizes and sections .. 6d. lb.
If in coils .. .. 3d. lb.
Packing .. ..5s. cwt
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces .. .. 5d.
Turnings and swarf .. 2d.
Per lb. net, d/d steel makers' works.

SCRAP

South Wales—£ s. d	£	s.	d.
Heavy Steel 3 5 0	3	15	0
Bundled steel & shearings	2	15	0
Mixed iron & steel ..2 10 0	3	5	0
Heavy cast iron ..	3	15	0
Good machinery for foundries ..	5	15	0
Cleveland—			
Heavy steel ..	2	17	6
Steel turnings ..	2	1	0
Cast-iron borings	2	0	0
Heavy wrought iron piling	3	7	6
Bundling scrap ..	3	5	0
Cast-iron scrap ..	4	10	0
Lancashire—			
Cast iron scrap ..	5	10	0
Heavy wrought ..	3	0	0
Steel turnings ..	2	5	0

London—	£	s.	d.
Copper (clean) ..	50	0	0
Brass (clean) ..	26	0	0
Lead (less usual draft)	18	0	0
Tea lead	16	0	0
Zinc	13	0	0
New aluminium cuttings ..	50	0	0
Brazier copper ..	40	0	0
Gun metal ..	38	0	0
Hollow pewter ..	115	0	0
Shaped black pewter	65	0	0

PIG-IRON.

(Premiums required for foundry).

N. E. Coast—	
Foundry No. 1 ..	—
Foundry No. 3 ..	120/-
Forge No. 4	112/6
Mottled	110/-
Hematite No. 1 ..	132/6
Hematite M/Nos. ..	130/-
Midlands—	
Staffs. common ..	145/-
„ part-mine forge	160/-
„ „ foundry	180/-
„ Cold blast ..	—
„ basic	—
Northants forge ..	120/-
„ foundry No. 3	125/-
„ basic	—
Derbyshire forge ..	125/-
„ foundry No. 3	135/-
„ basic ..	—
Scotland—	
Foundry No. 1 ..	150/-
„ No. 3 ..	145/-
Hematite M/Nos. ..	155/-
Sheffield (d/d district)—	
Derby forge	130/-
„ foundry No. 3	135/-
„ basic	—
Lincs. forge	—
„ foundry No. 3	—
„ basic	—
E.C. hematite ..	143/-
W.C. hematite ..	145/-
All d/d in the district.	
Lancashire (d/d eq. Man.)—	
Derby forge	—
„ foundry No. 3	145/-
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	—
„ foundry No. 3	—
Summerlee foundry ..	170/6
Glengarnock foundry	173/-
Gartsherrie foundry	173/-
Monkland foundry ..	170/-

FINISHED IRON & STEEL.

Iron—	£	s.	d.
Bars (crown)	14	0	0
Angles ..	14	10	0
Tees to 3 united ins. ..	15	0	0
Nut and bolt ..	14	10	0
Hoops	17	5	0
Marked bars (Staffs.) ..	17	10	0
Gas strip ..	17	10	0
Bolts and nuts, ½ in. × 4 in.	28	0	0
Steel—			
Ship plates ..	14	0	0
Boiler plates ..	19	0	0
Chequer plates	14	10	0
Angles	13	10	0
Tees	14	10	0
Channels ..	13	15	0
Joists	13	10	0
Rounds, ½ in.–3-in.	12	0	0
Rounds, 3 in.–5½ in. ..	11	10	0
Flats, 5 in.–8 in.	13	0	0
Flats over 8 in.	13	0	0

	£	s.	d
Rails, heavy ..	12	10	0
Fishplates ..	19	0	0
Hoops	14	0	0
Black sheets, 24 g.	15	0	0
Galv. cor. sheets, 24 g.	19	0	0
Galv. fencing wire, 8 g. plain ..	17	10	0
Rivets, ½ in. dia	22	0	0
Billets, soft ..	7	10	0
Billets, hard ..	8	10	0
Sheet and tin bars	8	5	0

PHOSPHOR BRONZE.

	Per lb basis.
Strip	1 5½
Sheet	1 6½
Wire	1 6
Rods	1 5½
Tubes	1 8
Castings	1 3½

Delivery 3 cwt. free to any town.
10% phosphor copper, £40 above price of B.S.
15% phosphor copper, £50 above price of B.S.
Phosphor tin (5%), £30 above price of English ingots.
Charles Clifford & Son, Limited, Birmingham.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	1/- to 1/6
Rolled—	
To 9 in. wide	1/7 to 2/1
To 12 in. wide	1/7½ to 2/1½
To 15 in. wide	1/8½ to 2/2½
To 18 in. wide	1/9½ to 2/3½
To 21 in. wide	1/10½ to 2/4½
To 24 in. wide	1/11½ to 2/5½
Ingots for spoons and forks ..	1/- to 1/6
Ingots rolled to spoon size ..	1/3 to 1/9
Wire round—	
3/0 to 10. G. ..	1/9½ to 2/4½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	21.84
No. 2 foundry Valley	21.00
No. 2 foundry, Birm.	19.00
Basic	21.21
Bessemer	21.96
Malleable	22.46
Grey forge	21.96
Ferro-manganese 80 % delivered	60.00
Bess. rails, h'y, at mill	45.00
O.-h. rails, h'y, at mill	47.00
Bess. billets	29.00
O.-h. billets	29.00
O.-h. sheet bars ..	32.00
Wire rods	41.00
	Cents.
Iron bars, Phila. ..	1.95
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel ..	1 65
Skelp, sheared steel ..	1.65
Steel hoops	2.25
Sheets, black, No. 28 ..	3.00
Sheets, galv., No. 28 ..	4.00
Sheets, blue an'l'd, 9&10	2.25
Wire nails	2.90
Plain wire	2.60
Barbed wire, galv. ..	3.55
Tinplate, 100-lb. box ..	$5.25

COKE.

Welsh foundry 57/6
„ furnace .. Nominal
Durham & North. foundry 53/-
„ furnace 35/-
Other Districts, foundry 60/-
„ furnace 23/-